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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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VOLUME 16 NUMBER 12 / JUNE 23, 1978

TABLE OF CONTENTS

AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

01 AERONAUTICS (GENERAL) 1521

02 AERODYNAMICS 1521

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*.

03 AIR TRANSPORTATION AND SAFETY 1523

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION 1524

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command and Tracking* and *32 Communications*.

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 1528

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

06 AIRCRAFT INSTRUMENTATION 1529

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

07 AIRCRAFT PROPULSION AND POWER 1530

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

08 AIRCRAFT STABILITY AND CONTROL 1537

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

09 RESEARCH AND SUPPORT FACILITIES (AIR) 1538

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*.

12 ASTRONAUTICS (GENERAL) 1539

For extraterrestrial exploration see *91 Lunar and Planetary Exploration*.

13 ASTRODYNAMICS 1540

Includes powered and free-flight trajectories; and orbit and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) N.A.

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air)*.

15 LAUNCH VEHICLES AND SPACE VEHICLES 1541

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

16 SPACE TRANSPORTATION 1542

Includes passenger and cargo space transportation, e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING N.A.

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 1542

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

19 SPACECRAFT INSTRUMENTATION 1543
For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

20 SPACECRAFT PROPULSION AND POWER 1543
Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.
For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

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23 CHEMISTRY AND MATERIALS (GENERAL) 1545
Includes biochemistry and organic chemistry.

24 COMPOSITE MATERIALS 1546
Includes laminates.

25 INORGANIC AND PHYSICAL CHEMISTRY 1547
Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.
For related information see also *77 Thermodynamics and Statistical Physics*.

26 METALLIC MATERIALS 1550
Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 1555
Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

28 PROPELLANTS AND FUELS 1557
Includes rocket propellants, igniters, and oxidizers; storage and handling; and aircraft fuels.
For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion*.

ENGINEERING

Includes engineering (general); communications; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.
For related information see also *Physics*.

31 ENGINEERING (GENERAL) 1560
Includes vacuum technology; control engineering; display engineering; and cryogenics.

32 COMMUNICATIONS 1561
Includes land and global communications; communications theory; and optical communications.
For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking*.

33 ELECTRONICS AND ELECTRICAL ENGINEERING 1566
Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.
For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

34 FLUID MECHANICS AND HEAT TRANSFER 1570
Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.
For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

35 INSTRUMENTATION AND PHOTOGRAPHY 1575
Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.
For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation*.

36 LASERS AND MASERS 1576
Includes parametric amplifiers.

37 MECHANICAL ENGINEERING 1580
Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

38 QUALITY ASSURANCE AND RELIABILITY 1582
Includes product sampling procedures and techniques; and quality control.

39 STRUCTURAL MECHANICS 1583
Includes structural element design and weight analysis; fatigue; and thermal stress.
For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

GEOSCIENCES

Includes geosciences (general); earth resources; energy production and conversion; environment pollution; geophysics; meteorology and climatology; and oceanography.
For related information see also *Space Sciences*.

42 GEOSCIENCES (GENERAL) 1586

43 EARTH RESOURCES 1586
Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.
For instrumentation see *35 Instrumentation and Photography*.

44 ENERGY PRODUCTION AND CONVERSION 1595
Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.
For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation*.

45 ENVIRONMENT POLLUTION 1604
Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

46 GEOPHYSICS 1607
Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.
For space radiation see *93 Space Radiation*.

47 METEOROLOGY AND CLIMATOLOGY 1611
Includes weather forecasting and modification.

48 OCEANOGRAPHY 1613
Includes biological, dynamic and physical oceanography; and marine resources.

LIFE SCIENCES

Includes life sciences (general); aerospace medicine; behavioral sciences; man/system technology and life support; and planetary biology.

51 LIFE SCIENCES (GENERAL) 1615
Includes genetics.

52 AEROSPACE MEDICINE 1615
Includes physiological factors; biological effects of radiation; and weightlessness.

53 BEHAVIORAL SCIENCES 1617
Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT 1617
Includes human engineering; biotechnology; and space suits and protective clothing.

55 PLANETARY BIOLOGY N.A.
Includes exobiology; and extraterrestrial life.

MATHEMATICAL AND COMPUTER SCIENCES

Includes mathematical and computer sciences (general); computer operations and hardware; computer programming and software; computer systems; cybernetics; numerical analysis; statistics and probability; systems analysis; and theoretical mathematics.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL) N.A.

60 COMPUTER OPERATIONS AND HARDWARE 1619
Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering*.

61 COMPUTER PROGRAMMING AND SOFTWARE 1621
Includes computer programs, routines, and algorithms.

62 COMPUTER SYSTEMS 1625
Includes computer networks.

63 CYBERNETICS 1625
Includes feedback and control theory.
For related information see also *54 Man/System Technology and Life Support*.

64 NUMERICAL ANALYSIS 1627
Includes iteration, difference equations, and numerical approximation.

65 STATISTICS AND PROBABILITY 1631
Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 SYSTEMS ANALYSIS 1633
Includes mathematical modeling; network analysis; and operations research.

67 THEORETICAL MATHEMATICS 1634
Includes topology and number theory.

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Includes physics (general); acoustics; atomic and molecular physics; nuclear and high-energy physics; optics; plasma physics; solid-state physics; and thermodynamics and statistical physics.
For related information see also *Engineering*.

70 PHYSICS (GENERAL) N.A.
For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar Physics*.

71 ACOUSTICS 1634
Includes sound generation, transmission, and attenuation.
For noise pollution see *45 Environment Pollution*.

72 ATOMIC AND MOLECULAR PHYSICS 1635
Includes atomic structure and molecular spectra.

73 NUCLEAR AND HIGH-ENERGY PHYSICS 1636
Includes elementary and nuclear particles; and reactor theory.
For space radiation see *93 Space Radiation*.

74 OPTICS 1637
Includes light phenomena.

75 PLASMA PHYSICS 1638
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

76 SOLID-STATE PHYSICS 1641
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

77 THERMODYNAMICS AND STATISTICAL PHYSICS N.A.
Includes quantum mechanics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

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80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1645
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84 LAW AND POLITICAL SCIENCE N.A.
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1648
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 1649
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 1650
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 1650
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

92 SOLAR PHYSICS 1651
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 1652
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

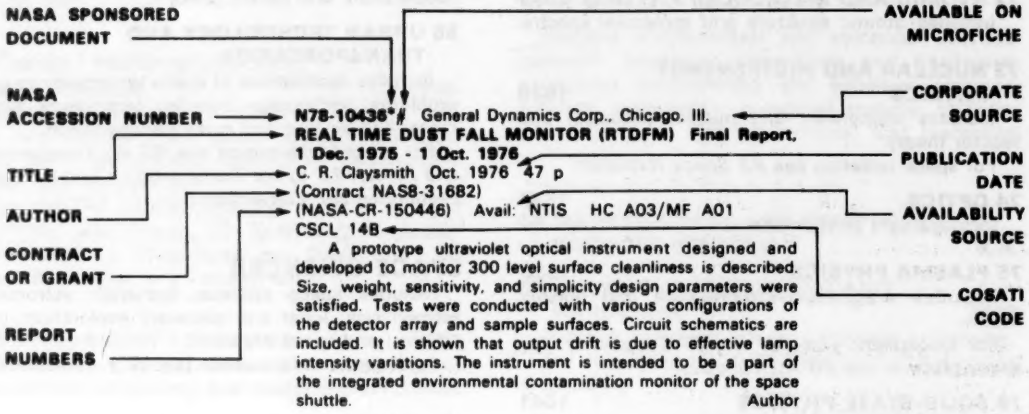
GENERAL

99 GENERAL 1652

Note: N.A. means that no abstracts were assigned to this category for this issue.

SUBJECT INDEX I-1
PERSONAL AUTHOR INDEX I-43
CORPORATE SOURCE INDEX I-51
CONTRACT NUMBER INDEX I-63
REPORT/ACCESSION NUMBER INDEX I-67

TYPICAL CITATION AND ABSTRACT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NASA ACCESSION NUMBER
N78-10436*# General Dynamics Corp., Chicago, Ill.
CORPORATE SOURCE
REAL TIME DUST FALL MONITOR (RTDFM) Final Report, 1 Dec. 1975 - 1 Oct. 1976
TITLE
C. R. Claysmith Oct. 1976 47 p
PUBLICATION DATE
(Contract NAS8-31682)
AUTHOR
(NASA-CR-150446) Avail: NTIS HC A03/MF A01
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CONTRACT OR GRANT
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REPORT NUMBERS
A prototype ultraviolet optical instrument designed and developed to monitor 300 level surface cleanliness is described. Size, weight, sensitivity, and simplicity design parameters were satisfied. Tests were conducted with various configurations of the detector array and sample surfaces. Circuit schematics are included. It is shown that output drift is due to effective lamp intensity variations. The instrument is intended to be a part of the integrated environmental contamination monitor of the space shuttle.
Author

ON-GOING RESEARCH PROJECTS

This is a listing of research projects— not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, TURBINE ENGINE LOW ASPECT RATIO TECHNOLOGY

W. WATERMAN, Garrett Corporation, *Phoenix, Arizona* 85034 (DF456730; F33615-74-C-2017)

This program extends the successful technology of AF contract F33615-68-C-1208 to low aspect ratio turbine blade problems, especially for high-temperature cooled blades.

A time-phased effort to identify the loss mechanisms of low aspect ratio cooled turbines will be pursued. Cold stationary and rotating rigs will be used to verify loss mechanisms and evaluate methods to reduce these losses. The approach to this improvement is expected to extend the work of F33615-68-1208.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0002, STUDY OF COST/BENEFIT TRADE-OFFS AVAILABLE IN AIRCRAFT NOISE TECHNOLOGY APPLICATIONS IN THE 1980'S

UNKNOWN, Bolt Beranek & Newman Inc., *Canoga Park, California* 91303 (FA77WA-4037; FA160431 (TRAIS NO.))

The contractor shall identify the technologies including but not limited to application of sound-absorbing material, low-noise jet nozzles, and high bypass ratio engines available for lowering noise levels from subsonic commercial jet, business jet, and general aviation aircraft. This must be done both for two totally new and for two derivative aircraft types. Retrofit of aircraft already in service shall not be considered in this study.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0003, WIND TUNNEL TESTING OF A WING/STORE FLUTTER PREVENTION SYSTEM

C. HWANG, Northrop Corporation, *Hawthorne, California* 90250 (DF133940; F33615-76-C-3039)

High-performance fighter-attack aircraft are required to carry many combinations of external wing mounted stores to obtain operational effectiveness as regards the combat role. However, some wing/store configurations are found to be critical from the standpoint of preventing flutter from occurring within the desired operational flight envelope. Speed placards are the only suitable means of preventing this flutter, but this technique generally results in significant losses in aircraft performance. The objective of this program is to investigate, via wind tunnel testing of an aeroelastic model with external stores, the potential capability of an adaptable flutter suppression system of removing flutter speed restrictions. The technology gained from this program will ultimately result in an expanded attack envelope, increased survivability (reduced cost per target kill) and improved operational flexibility on fighter aircraft with an air-to-ground mission.

An aeroelastic wind tunnel model of a fighter aircraft configuration will be designed and fabricated. A miniature flutter suppression system will be synthesized, constructed and implemented within this model. The active system will be mechanized with digital logic and electro-hydraulic actuation, and will be capable of adapting to prevent the flutter modes of several wing/store configurations. Finally, wind tunnel tests will be conducted to evaluate several important design parameters.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0004, SONIC FATIGUE DESIGN DATA FOR BONDED ALUMINUM AIRCRAFT STRUCTURES

M.J. JACOBSON, Northrop Corporation, *Hawthorne, California* 90250 (DF135340; F33615-75-C-3144)

Renewed interest in bonded aircraft structures requires the availability of design information which will enable the structural designer to determine the sonic fatigue life of the structure. The objective of this program is to investigate bonded structural joints and to develop sonic fatigue design criteria for bonded structures.

Conduct analytical and experimental investigations to determine the dynamic characteristics of bonded structures when excited by jet noise or turbulent boundary layer oscillations. The structural fatigue resulting from the dynamic loading will be investigated experimentally and will be combined with the analytical results to obtain sonic fatigue design criteria for bonded aircraft structures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0005, ADVANCED TECHNOLOGY AND DEVELOPMENT FOR AIR FORCE FLIGHT DYNAMICS SYSTEM PROBLEMS

C.T. LEONDES, Univ. of California, School of Engin. & Appl. Sci., *Los Angeles, California* 90024 (DF139380; F33615-76-C-3009)

This program is for research and development in advanced control theory and technology for application to advanced vehicles and control system problems. This program will help to solve existing Air Force problems. The objective of this program is to formulate a functional flight control design. This new designs can be utilized on new aircraft systems such as AFTI.

Eleven tasks or study efforts will be investigated. Five of these tasks are essential to preliminary design of an AFTI-type vehicle and will be emphasized. These are sub-optimal control theory for precise terminal control problems as applied to air combat or air-to-ground role. New mathematical approaches will be utilized which may tend to produce new methods to solve existing flight dynamics problems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0006, RESEARCH ON HELICOPTER ROTOR NOISE 13517-EX

H. LIEBOWITZ, George Washington Univ., School of Engin. & Appl. Sci., *Washington, District of Columbia* 20037 (DA0E9139; DAAG29 77 G0174)

To extend current knowledge of high-speed helicopter rotor noise by determining the influence of non-compact source distribution on high-speed rotor blade tips, the influence of aerodynamic pressure distribution on radiated near and far acoustic fields and influence of unsteady pressure fluctuations on radiated noise. Relevance - high-speed rotor noise studies are very relevant to Army missions of the next few years. Blade slap must be reduced if the true advantages of nap-of-the-earth flight are to be realized. This study is also relevant to determining detectability, community annoyance and possible effects of FAR 36 on new helicopter designs.

The non-homogeneous wave equation describing the radiated acoustic pressure will be solved both analytically, where possible, and numerically in a form that removes the restrictions of compactness, hovering rotors, far-field approximation, geometry, and mathematical singularities characteristic of high tip speeds.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

1.0007, SERVICES AND SUPPORT TO THE NASA/ARC REDUCTANT RECONFIGURABLE DIGITAL FLIGHT CONTROL SYSTEM
UNKNOWN, U.S. Natl. Aero. & Space Adm., *Washington, District of Columbia* 20553 (FA77WAI-738; FA160016 (TRAIS NO.))

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0008, ADVANCED ENGINE SIMULATION
J. ALCOCK, United Technologies Corp., *West Palm Beach, Florida* 33402 (DF459200; F33615-76-C-2048)

Establish a procedure that provides technical direction and guidance to the development of advanced propulsion system concepts yielding improved system performance.

The procedure will be developed by logically and systematically interpreting the technical data base, generated in phase I of the turbine engine variable cycle selection programs, to identify advanced propulsion system concepts, advanced scheduling/control system concepts and advanced component technology requirements that yield improved system performance.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0009, STRUCTURAL DYNAMICS LABORATORY
M. LEE, General American Trans. Corp., *Chicago, Illinois* 60648 (DF641550; F08635-77-C-0103)

Air Force function - this work unit is established to define aircraft and store structural dynamic characteristics. Deficiency or opportunity - currently there exists no way for the actual modal dynamic characteristics to be defined. Objective - to design and install soft suspension equipment which will be used to define aircraft and store dynamic modal characteristics for flutter solutions. How work contributes - this work will allow for the prediction of catastrophic failure of the aircraft and store during flight.

Design and install a soft suspension equipment and perform dynamic modal analyses and use to predict flutter of aircraft and store combinations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Armament Lab.

1.0010, DIRECT INITIATION OF DETONATION AND BLAST EFFECTS FROM UNCONFINED FUEL-AIR EXPLOSIONS
R.A. STREHLOW, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DF036910; AF-AFOSR-2524-73)

AF function - advanced chemical explosive weapons, weapon delivery and defense, close air support, aircraft component vulnerability and survivability. Deficiency - insufficient understanding of basic mechanisms and dynamic processes of initiation, propagation, attenuation and quenching of blast waves, flames and detonations in reactive media and lack of realistic guidelines for predicting properties and blast potentials of unconfined homogeneous and heterogeneous explosions and for evaluating the vulnerability of aircraft components, (e.g., fuel tanks) to flames blast and detonation waves. Objective - to formulate mathematical models realistically describing the mechanisms responsible for initiation propagation and attenuation of unconfined cloud detonations and non-ideal blast waves in reactive media. How work contributes - will provide additional understanding of initiation propagation, attenuation and quenching mechanisms of flames, blast and detonation waves in reactive media not now available, will provide easy laboratory evaluation of potential FAE fuels and fuel modifiers, and will contribute to establishing realistic guidelines for developing advanced high-power chemical explosive (FAE) devices and effective flame and detonation arrestors.

Direct comparison and correlation will be made of initiation behavior with measured characteristic transverse wave size of propagating self-sustained C-J detonations, and direct study will be made of the effect of combustion modifiers on induction delay times and heat release for various fuels and fuel-combustion modifiers of interest to the Air Force, using reflected shock tube techniques. Concurrently the initiation process will be studied theoretically, including determination of the nature of the spherical shock wave decay as a function of energy release rate at the ignition source. A physically realistic mathematical model of the initiation process will be formulated using a method of characteristics in spherical coordinates, ray tracing techniques and non-ideal blast wave theory. In addition, interaction of blast waves with chemical kinetics for different non-ideal source deposition processes will be studied, and minimum deposition energy to produce local explosion will be determined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

1.0011, AEROSAT USER'S AIRBORNE SYSTEMS INTEGRATION AND DATA COLLECTION
UNKNOWN, A R I N C Research Corporation, *Annapolis, Maryland* 21401 (FA58668; FA75WA-3686)

This multi-year program includes an evaluation of the factors necessary to make the L-band and VHF avionics tests comparable and the assessment of cost factors associated with the AEROSAT avionics program. A preliminary design study will determine the installation requirements. This includes a continuing review of both the L-band and VHF specification parameters as applicable to installation in air carrier aircraft. A detailed design study will be followed by the installation of one airborne system in a selected aircraft type and flight tests of the complete system.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

1.0012, BOUNDARY LAYER AND WAKE MODIFICATIONS TO COMPRESSOR DESIGN SYSTEMS
J.L. KERREBROCK, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF460690; F33615-76-C-2118)

To devise a model for a turbomachine stage in which the radial transport of momentum and energy by the boundary layer and wake flows are accounted for approximately, so that cascade-throughflow design techniques can be applied rationally without ad hoc corrections for these effects. A fast running computer code will be developed which is suitable for routine design and analysis.

The elements of rotor boundary layer and wake transport will be added to an existing throughflow-cascade model, calibrated and compared to detailed experimental data. Further data will be explored to examine radial distributions of work and meridional velocity. Radial transport effects of wakes between rotor and stator and in the stator will be added to the model and further compared to experimental results.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0013, FATIGUE CRACK GROWTH UNDER RANDOM LOADING USING ANALOG COMPUTERS

J.F. MCCARTHY, Mass. Inst. of Technology, Center for Space Research, *Cambridge, Massachusetts* 02139 (DF137400; F33615-76-C-3109)

Structural safety of current and future USAF tactical and strategic aircraft is a continuing problem. To insure that prescribed levels of safety are achieved for individual aircraft methods must be developed to assess the variability of crack growth caused by variations in aircraft service loading within a given mission profile. These methods will lead to improved tracking programs providing increased safety and more cost effective operation of USAF aircraft.

Analog computation schemes for crack growth calculations have been demonstrated to be feasible and useful for Monte Carlo simulations to obtain final crack size distributions for simple crack growth models. This effort will extend the analog simulation technique to more sophisticated crack growth models and load history representations by incorporating stress ratio effects and ground-air-ground cycles.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0014, LOW-TEMPERATURE FABRICATION OF HIGH-EFFICIENCY SILICON SOLAR CELLS

A. KIRKPATRICK, Simulation Physics Inc., *Foxboro, Massachusetts* 02035 (DF457490; F33615-75-C-2006)

The objective of this program is twofold: first, to develop the technology for low-temperature pulsed electron beam process fabrication of n plus/pp plus silicon solar cells with shallow ion implanted junction (the solar cells will have better than 14 percent airmass zero efficiency after seven years of operation in synchronous orbits), and, second, to demonstrate the feasibility of using the low-temperature pulsed electron beam process for high production rate of solar cells (greater than one 2 centimeter by 2 centimeter solar cell per second).

The contractor shall conduct an experimental investigation to develop the techniques to fabricate n plus/pp plus silicon solar cells using pulsed electron beam processing to anneal ion implant damage and to suiter the electrical contacts and the antireflective coating. The contractor shall conduct computer-aided analytical studies in support of experimental findings. The contractor shall test fabricated silicon solar cell samples in electron and neutron environments. The contractor will perform current voltage characterization measurements on completed solar cells.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0015, PAVEMENT DETERIORATION ANALYSIS

V.C. BARBER, U.S. Army, Waterways Experiment Station, *Vicksburg, Mississippi* 39180 (DA0T8181)

To develop methodolgy for the analysis of and prediction of functional and structural deterioration and the resultant attrition of serviceability of airfields and roads. To define all pertinent modes of deterioration, their respective mechanisms and rates and influence upon pavement system deterioration. To develop methodology for incorporation of these developments into design, maintenance, and evaluation procedures in a manner to provide for pavement life-cycle management.

The effort will be structured on a long-range (about 5 years) basis with intermediate milestones that will be reached upon completion of specific efforts. The approach consists of collecting appropriate data, developing deterioration analysis methodology, and incorporating the methodolgy into design, maintenance, and evaluation procedures.

SUPPORTED BY U.S. Dept. of Defense, Army, Office Chief of Engineers

1.0016, STATIC ELECTRICITY HAZARDS IN AIRCRAFT FUEL SYSTEMS

W.G. DUKEK, Exxon Res. & Engineering Co., *Linden, New Jersey* 07036 (DF461630; F33615-77-C-2046)

Define design criteria for USAF fuel systems to decrease fuel static electricity hazards. Determine compatibility of existing aircraft fuel systems with fuels having a wide range of electrical conductivity.

Contract to Exxon Res. and Engr. Co. to conduct series of experimental tests to determine good and bad design practices.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0017, ADVANCED TURBINE MATERIALS DEMONSTRATION

A. SHEXSCHNEIDER, General Electric Company, *Cincinnati, Ohio* 45215 (DF459660; F33615-76-C-2150)

Demonstrate the capability of a Si/SiC ceramic turbine shroud to perform satisfactorily in an operational engine.

Design shroud supports and shroud materials to be tested in a cf-6 or an LM 2500.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0018, CONSTITUTIVE REPRESENTATION AND LIFE PREDICTION METHOD FOR RENE 95

D.C. STOUFFER, Univ. of Cincinnati, School of Engineering, *Cincinnati, Ohio* 45221 (DF045940; AF-AFOSR-3101-77)

AF function - durability and life cycle costs of aerospace flight vehicles is of major concern to the Air Force. Deficiency - technology base uncertainties exist in the reliability of predicting fracture and fatigue damage occurring in Air Force airframe and engine structures. Objective - the objective of this research is to understand through material constitutive behavior the interaction of creep and fatigue in the failure process. How work contributes - this research contributes to the development of an improved Air Force damage-tolerant design criterion.

The principal investigator will investigate improved constitutive equation representations accounting for creep and plastic strain effects. ReNe 95 will be used as particular material for this study. Research will focus on rate effects and extension of strain-range partitioning life prediction methods to include this effect.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

1.0019, COMPOSITE SPECIMEN FABRICATION AND TEST

R.T. ACHARD, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF139700)

This work unit is supportive to preliminary design and evaluation of advanced structural composite materials and basic material processing techniques, and is to include activities related to construction and testing of standard specimens and representative structural geometries using advanced composite materials. The capability to explore technology under parallel investigation by civilian industry, on a much reduced scale, leads to a more thorough understanding and to some degree allows anticipation of problems related to technology development for Air Force aircraft structures application. The objectives of this effort are to perform in-house fabrication and assessment of payoff potential, through inspection and test, of composite structural concepts, arrangements, and geometries including bonded assemblies and hybrid assemblies where applicable. The in-house approach allows for direct dollar savings as well as indirect savings associated with more timely responses to current problems. Timely responses based on thorough understanding permits a more time- and cost-effective approach to the solution of problems inherent in advanced structural design and development.

Efforts within this work unit will include, but not be limited to, the following: fabrication of unique test specimens, analysis and test of composites in various simulated environments; fabrication of fracture mechanics coupons; development, fabrication and test of elastomeric tooling concepts; support of composite investigations by other laboratory agencies as requested; investigation of an automatic scanning dielectric spectrometer, for monitoring and improving composite cure cycle efficiency; creation and maintenance of displays illustrative of composite applications

in airframes; and conducting of tours and presentations explanatory thereof as required.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0020, PERFORMANCE TESTS OF HYDRAULIC POWER TRANSFER UNITS

K.E. BINNS, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF457430)

To conduct performance tests on rotary and oscillating piston-type power transfer units to provide comparison data for future hydraulic system applications. Specific areas to be emphasized are breakout pressures, stability, noise, pulsations, and efficiency.

A rotary-type power transfer unit presently used on the C-5 aircraft has been purchased and will be tested in a special test setup to be fabricated in room 16, building 18. A prototype oscillating piston power transfer unit which is a delivery item under contract F33615-72-C-1078 will then be tested under identical conditions using the same test setup.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0021, TURBINE ENGINE INTEGRATION ANALYSIS PROCEDURES

E.G. BLEVINS, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF452670)

To generate the propulsion system (inlet, engine, exhaust) performance trends and establish the engineering techniques necessary for improving delivered thrust-fuel flow characteristics during engine part-power operation.

Generate time-phased analysis and test techniques that forecast elemental propulsion system performance to defined levels of accuracy. Identify critical tests that must occur to define exhaust system -engine performance intereffects. Identify engine and exhaust system internal changes that are necessary to maximize delivered thrust at low throttle ratios.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0022, FEASIBILITY OF INCREASED SIMULATION CAPABILITY THROUGH IMPROVED SIMULATION HARDWARE PERFORMANCE

R.W. HENSLEY, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF132890)

The application of engineering flight simulation for the evaluation and development of current and future Air Force systems is increasing and hardware adequate and suitable for the task must be available. The objective of this work effort is to increase the simulation capability of the existing facility by improving the performance of the simulation hardware. Maintainability and reliability improvements may result as a byproduct of this effort. The adequacy and validity of simulation program results will be enhanced through this effort.

Feasibility studies will be conducted to determine the effectiveness and desirability of equipment modifications which will improve their performance. Examples are visual system angular deflections and rate limitations, motion system travel and rate limitations, cockpit control feel systems and location and type of flight instruments. Limited experiments may be conducted to validate improvement required, recommend equipment modifications, and acquire pertinent hardware.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0023, NAVIGATION/FLIGHT CONTROL INTERFACE TECHNOLOGY

J.A. KOCHER, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF134830)

With the impending imposition of area navigation upon the civil and military fleet, no definition has been given to the control techniques and accuracy requirements to comply with future national airspace system criteria. The objective is to establish technical requirements for aircraft operations in the area navigation enroute and terminal area flight structures. Information contributing to precise spatial control of Air Force flight vehicles will be generated by this effort.

A study will be made of the navigation requirements from the area navigation enroute flight structure to the terminal area final approach fix. A set of route requirements will be developed to define the various possible maneuvers. The maneuvers will then be studied to determine what restrictions may be required due to the performance characteristics of various aircraft.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0024, MULTIPLE FRAGMENT IMPACTS ON SINGLE ENGINE AIRCRAFT FUEL SYSTEMS

P.M. MURAWSKI, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF138480)

The objective of this program is to evaluate the effects of multiple fragment impacts on single engine-type aircraft fuel systems. These effects include hydraulic ram/structural damage, fuel ingestion, fire, and explosion. This program is designed to evaluate the range of test/target conditions which allow the results to be applied to a wide variety of warhead types (i.e., varying frag densities, mass, velocity, etc.) and aircraft configurations (i.e., thin skin, thick skin, full tanks, ullage, etc.). The data generated will be applicable to any single wall-type aircraft fuel tank where fragments would impact the tankage directly (as opposed to passing through a dry bay, void space, or inlet duct first).

This program will be a multi-phased, multi-year test and evaluation with specific milestones to be met for each phase. Various parameters will be tested, including frag velocities of 3.0, 4.5, 6.5, 8.0 thousand ft/sec, densities of 2, 5, 10, 18 frags per ft, and frag weights of 10, 30, 60, 120, and 240 grains. Various launching techniques will also be tested.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0025, CRF/J85 TRANSIENT INVESTIGATION

F. OSTDIEK, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF460550)

The primary objectives of this program are to determine the effects of speed transients on compressor performance, to obtain detailed information on compressor operating paths during transient operation, and to investigate the cause of compressor performance differences between transient and steady-state operation. This information will primarily be used to evaluate transient compressor test techniques for application to APL's CRF.

A J85-5 engine will be instrumented for transient compressor testing, the instrumentation will be interfaced with a MOD COMP II computer system for storage and processing of test data. An analysis of the data will be made in order to relate specific aerodynamic parameters to changes in performance that result during transient operation that can lead to compressor stall.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0026, INVESTIGATION OF KEVLAR MATERIALS FOR DECELERATOR APPLICATIONS

W.R. PINNELL, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF136570)

Many military missions currently being performed incorporate a requirement for deployable aerodynamic decelerator systems to stabilize and/or recover special purpose payloads over a range including small electronic countermeasure devices and entire operational aircraft. The problem addressed by this effort is the reduction of the weight and volume required for decelerator systems. The objective of this effort is to integrate Kevlar 29, a high-strength-to-weight fiber for textile materials, into decelerator system technology. Application of the Kevlar 29 textiles will permit volume and weight reductions of approximately 50 percent when compared to currently used nylon materials.

Experimental Kevlar parachutes will be tested in a controlled manner to determine proper design criteria for efficient Kevlar 29 utilization. Test items will be 15.3 ft conical ribbon parachutes. Horizontal ribbons and suspension lines are the parachute components of primary interest.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0027, ACOUSTICS RESEARCH

R.M. SHIMOVETZ, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF140680)

Various problems encountered in the development of af weapon systems are related to the noise generated by the propulsion systems and pseudo-noise associated with flight through the atmosphere. These problems include degradation of the structural integrity, equipment reliability, crew health and performance, and aircraft survivability. The objective is to develop methods for the prediction and control of exterior and internal noise of military aircraft. The physical and geometric parameters of sources which are known will be correlated to the characteristics of the noise and aeroacoustic fields and will accurately predict the spectra level, acoustic power, directivity, and correlation characteristics. These prediction methods will be in the form of design charts, computer programs, specifications, and acoustic and vibration criteria.

Existing methods of noise source estimation will be correlated into design charts and computer programs providing non-acoustician users an easily computational means of obtaining near-field noise estimates of aircraft sources. Vibration and acoustic levels on the X-24B pseudo noise will present the measurements and present prediction methods for boundary layer pressure oscillations. Weapons bay cavity pressure oscillation problem studies will be extended to publishing recent work in the flight test demonstration of suppression devices and slender cavities noise prediction for the ALBM (air-launched ballistic missile). YC-14 and YC-15 noise prediction efforts will include performing data and engineering analysis of the internal noise and STOL flap loads measuring programs which are contracted but may not be funded to complete the engineering analysis and report. Another area of this effort will be allocated to predicting the total radiated airframe acoustic power.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0028, FLIGHT LOADS SIMULATION CAPABILITY

F.K. BOGNER, Univ. of Dayton, School of Engineering, *Dayton, Ohio* 45409 (DF138400; F33615-76-C-3135)

There is currently no facility in existence in the free world in which flight loads on an aircraft structure can be realistically simulated during a ballistic impact on the structure. Also, it is presently very difficult, if not impossible, to determine residual strengths of large sections of aircraft structure after they have been damaged by ballistic impact. The objective of this effort is to design and fabricate a loading system which will have the dual capability listed above. Development of such a facility will result in greatly improved simulation during survivability/vulnerability tests on USAF aircraft.

A contractor will be selected through a multiple-source procurement to perform this effort. The contractor will design and build the loading system which will be installed in the AFFDL vertical gun range. In addition, the contractor will supply test specimens which will be tested in the facility to evaluate its performance. The contractor will also develop an analysis capability as a part of this effort which can be used to predict stresses and probable points of failure in ballistically damaged aircraft structure.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0029, SUPERCONDUCTING FIELD WINDING TEST

R. BLAUGHER, Westinghouse Electric Corp., *Pittsburgh, Pennsylvania* 15235 (DF458570; F33615-75-C-2077)

To obtain and evaluate data concerning the performance of superconducting wire in a controllable environment similar to that in a high-speed alternator rotor. Anomalous superconducting behavior occurred during rotor accelerations in the initial rotor of phase I of the superconducting generator development program (F33615-71-C-1591). Several plausible explanations for the degraded performance have been presented since these tests, but verification of the source and solution of the problem has not been attempted. This program will furnish information to evaluate the final rotor design of contract F33615-71-C-1591, and provide confidence to the projected generator designs developed under the superconducting alternator high-power study. The primary purpose of this program is to test superconducting coils under conditions that simulate the geometry, mechanical, and thermal (heat transfer) conditions existing in the rotor of superconducting generators of the type of interest to the USAF.

This six-month program shall be organized into five tasks. The first month shall be dedicated to the design of the rotating test facility. A meeting is to be held with AFAPL personnel at the end of the first month (DD 1423) in order to review the design, construction, schedule, and anticipated costs. The test facility shall be fabricated during the next 18 weeks. During the last 3 weeks of the fabrication period, the test stand shall be prepared along with setting up the required cryogenic and test equipment. Three weeks before the end of the fabrication phase, a test plan shall be submitted to the AFAPL for approval. The angular acceleration test runs shall be conducted during the last two weeks of the program.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

1.0030, AIRFRAME STRUCTURAL MECHANICS AIRCRAFT STRUCTURES

S.L. HUANG, U.S. Navy, Air Vehicle Technology Dept., *Warminster, Pennsylvania* 18974 (DN133126)

Evolve engineering hypotheses for use in determining residual strength, fracture resistance and crack growth behavior in structures as means of ensuring structural integrity of naval aircraft.

Develop and verify crack growth models suitable for automated application for prediction of safe life and residual strength of metallic aircraft structures. Utilize and refine existing and newly-developed finite-element methods in the localized analysis of typical structural assemblies. Apply advanced analytical procedures to develop and numerically quantify new strength and failure theories for composites, and design and perform experiments to demonstrate the various phenomena. Fabricate and test representative composite structural specimens after exposure to various environmental effects and/or subject to low-velocity impact. Some of this work is being performed under contract, as reported in work units DG 602-B6, B8, B9, B10.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

1.0031, ACTIVE FLUTTER SUPPRESSION FEASIBILITY STUDY

R.P. PELOUBET, General Dynamics Corporation, *Fort Worth, Texas* 76101 (DF140320; F33615-77-C-3081)

High-performance fighter-attack aircraft are required to carry many combinations of external wing-mounted stores to obtain operational effectiveness. However, some wing/store configurations are critical from the standpoint of preventing flutter from occurring within the desired operational flight envelope. Additional stiffness, mass ballast, or speed placards are the only suitable means of preventing this flutter, but these techniques generally result in significant losses in aircraft performance. The objective of this program is to investigate feasibility of developing an active flutter suppression system for an advanced fighter with wing-mounted external stores and to evaluate impact on the aircraft design and performance.

Conduct analyses for several store loadings to determine if a common flutter suppression system can be designed that stabilizes the various store loadings. Conduct a preliminary design study to determine the impact of the flutter suppression system on the design (e.g., stability and control, flight controls, weight, performance, reliability, and structural integrity).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

1.0032, FUNDAMENTAL MODELING OF KINETICS, MIXING AND EVAPORATION IN COMBUSTORS

J. SWITHENBANK, Univ. of Sheffield, *Sheffield, England, United Kingdom* (DF013410; AF-AFOSR-2682-74)

AF function - advanced air-breathing engines, airborne weapon delivery. Deficiency - insufficient understanding of basic mechanisms and processes involved in advanced air-breathing combustors and lack of realistic guidelines for predicting propulsion system performance and solution of combustor design problems. Objectives - to understand and develop accurate theoretical and mathematical models realistically describing the combustion phenomena encountered in advanced air-breathing ramjet and turbojet combustors and augmentors. How work contributes - will provide additional understanding and realistic analytical modeling of turbulent reactive flow fields not now available and will contribute to establishing realistic design criteria for efficient, stable and low polluting primary and secondary jet engine combustors. Also will aid in understanding combustion system limitations and hence in system optimization at design stages.

Parallel theoretical and experimental studies associated with modeling of ramjet and gas turbine combustors will be carried out. Emphasis will be on practical application of entrainment and turbulence theory and use of partially stirred chemical reactor theory to formulate phenomenological models for use in solution of combustor design problems. Included will be study of simultaneous influence of pressure, turbulence, unmixedness, multiple-reaction chemical kinetics, fuel preparation (e.g., droplet breakup, distribution and evaporation), steady and unsteady combustion in turbulent subsonic and supersonic air flows on combustor characteristics and performance. Theoretical model predictions will be verified experimentally using gas analyses, laser diffraction droplet size and turbulent density spectrum analyses and quantitative turbulent mixing analyses on subsonic and supersonic combustors.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

1.0033, INJECTION, ATOMIZATION, IGNITION, AND COMBUSTION OF LIQUID FUELS IN HIGH-SPEED AIRSTREAMS

J.A. SCHETZ, Virginia Poly. Inst. & St. U., School of Engineering, *Blacksburg, Virginia* 24061 (DF029130; AF-AFOSR-2584-74)

AF function - advanced air-breathing engines, external burning systems, weapon delivery and defense, transport. Deficiency - insufficient fundamental understanding of the problems associated with high-speed combustion phenomena in advanced practical combustor systems and lack of realistic guidelines for predicting injector/mixing system and combustor/propulsion system performance and operational characteristics and selection of acceptable liquid fuels. Objective - to formulate realistic analytical models describing the detailed physical and chemical processes involved in advanced turbojet and ramjet combustor concepts and external burning systems. How work contributes - will provide improved understanding and realistic analytical modeling of injection, breakup, mixing, vaporization and ignition phenomena not now available and will contribute to establishing guidelines and criteria for choosing acceptable fuels and in design and development of practical injector mixing systems and combustors of advanced engines, e.g., turbojet main-and after-burner, dump-vortex burners, dual-mode scramjet, and external burning systems.

Penetration, breakup, atomization and vaporization and ignition of liquid jets injected across a high-speed air stream will be studied in subsonic, transonic and supersonic facilities at various Mach numbers, and including conditions associated with external burning and 'dump combustors.' Emphasis will be directed toward understanding the basic fracture mechanisms, vapor pressure effects on the atomization process and the influence of liquid accumulation on the surface on near-field ignition processes. Ignition and combustion processes on liquid surface layers in the region of the injection port will be studied in an electrically heated air facility with a combustion-fired afterburner. Flow fields, atomization, vaporization and diffusion rate, and ignition and combustion details will be determined optically employing spark Schlieren, high-speed movies (up to 40,000 pic/sec) and infrared photography. Analytical descriptions of the phenomena will be developed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

1.0034, NONLINEAR ANALYSIS OF SQUEEZE FILM DAMPERS APPLIED TO GAS TURBINE HELICOPTER ENGINES 14100-E

E.J. GUNTER, Univ. of Virginia, School of Engin. & Appl. Sci., *Charlottesville, Virginia* 22903 (DA0F8937; DAAG29 77 C 0009)

To study nonlinear effects of dynamic loading arising from engine acceleration, sudden unbalance, and rotor misalignment on damper performance. Relevance - this research is very important to the rotor dynamics program at the Eustis Directorate in that it will provide a valuable tool in the analysis of whirl in bearings--of major importance in bearing systems for high-speed gas turbine engines.

Theoretical and experimental analyses, the former being based on the Reynolds equation from which regimes of stable journal operation will be obtained.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, CARBORANE BURNING RATE MODIFIERS FOR SOLID PROPELLANTS

W.E. HILL, Auburn University, School of Chemistry, *Auburn, Alabama* 36830 (DN590583; N00024-75-C-5318)

To perform research on carborane compounds for use as propellant burning rate catalysts. Three main problems will be investigated: (1) possibility of migration from the propellant, (2) undesirably high melting points, and (3) low yield synthesis.

To prevent migration, existing binders will be modified by using carboranyl plasticizers which react with double bonds of the polymers on curing. Hydroxy terminated polybutadiene (HTPB) and carboxy terminated polybutadiene (CTPB) polymers will be reacted with functional carboranes to make polymers containing boron which should not migrate easily. Silyl carboranes contain Si-Si bonds or Si-C bonds will be synthesized. These compounds should yield high burning rates with less carborane which should be less volatile. Difunctional carboranyl isocyanates and epoxides for use as curing agents will be synthesized. Meta-isomers of carborane derivatives will be prepared and compared with their ortho analogs in an effort to lower the melting point. Carboranes will be synthesized from acetylenes for improved yield.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Sea Systems Command

3.0002, LASER-INDUCED CHEMISTRY OF PROPELLANTS

J.A. MERRITT, U.S. Army, Radar Technology Laboratory, *Huntsville, Alabama* 35809 (DA0F1222)

Demonstrate and investigate the production of decaborane-14 by laser-induced photochemistry. Demonstrate and investigate laser initiated fast curing of propellants.

A laser-induced photochemistry facility will be designed and assembled to include a multigas tunable high-power pulsed IR laser and a Fourier-transform spectrometer for time-resolved measurement of reaction intermediates. Initially, multiline laser experiments will be performed in an attempt to validate pulsed laser enhancement of hydroborane and carborane formation. Experiments on laser curing of propellants will also be performed. Associated theoretical calculations will be performed.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Physical Sciences Directorate

3.0003, ABSOLUTE RATE CONSTANTS FOR COMBUSTION REACTIONS INVOLVING FREE RADICALS
D.M. GOLDEN, S R I International, *Menlo Park, California* 94025 (DF040370; F44620-75-C-0067)

AF function - future AF operations will exploit developments in the technologies of propulsion and power. To improve future AF weapon delivery systems, a fundamental understanding of the dynamics and thermochemistry of key reactions in the processes of combustion, pyrolysis and non-equilibrium gas dynamics is essential. Deficiency -there is presently a lack of understanding of the elementary gas kinetics of combustion processes needed for the design and development of improved air-breathing engines and more efficient, non-polluting and readily-available fuels. Objective - measure quantitatively the rate constants and extend current models for combination and disproportionation of free radicals. Apply unimolecular reaction rate theory to small molecules of atmospheric interest and to ion-molecule reactions. Explore the mechanism of IR photochemistry of representative molecules. How work contributes - measurements of key rate constants as well as the development of reaction rate models for important radical reactions will contribute to improved understanding of combustion and atmospheric processes.

The new very low pressure pyrolysis (VLPP) apparatus will be used for the key chain terminating processes of stabilized radicals with emphasis on allyl and benzyl systems. Modelling will be extended to other ion-molecule and radical-radical systems. A C02-TEA laser will be used to explore IR photochemistry to drive unique chemical reactions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0004, ANALYSIS OF AIRCRAFT ENGINE OIL SAMPLES BY NEUTRON ACTIVATION TECHNIQUES
T.A. MENARD, U.S. Air Force, Physics Dept., *Colorado Springs, Colorado* 80840 (DF282210)

A continuation of the feasibility study conducted during 1976, this study will attempt to determine the feasibility of using a Cf252 neutron source for activating aircraft oil samples as a means of supplementing the USAF spectroscopic oil analysis program. This project will determine if the neutron activation method is faster and/or more accurate than presently used methods of determining trace contaminants in oil.

(a) A Cf252 source will be obtained on loan from ERDA. (b) Calibration standards will be prepared and curves established for the 13 elements of interest in oil analysis. The approach will be to determine the optimum method for observing each element in order to obtain the lower limit in ppm plus or minus 10 percent. (c) Aircraft engine oil samples will be activated and the trace metal concentrations determined using the calibration curves. By comparing these results with those obtained by the soap methods a conclusion can be drawn concerning the value of this method in relation to the established methods.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Frank J. Seiler Research Lab.

3.0005, FATIGUE CRACK PROPAGATION IN TITANIUM ALLOYS
AJ. MCEVILY, Univ. of Connecticut, School of Engineering, *Storrs, Connecticut* 06268 (DF039080; AF-AFOSR-2703-74)

AF function - to improve what is known about structural materials used in Air Force flight systems so that current and new systems might achieve better reliability and prolonged service life. Deficiency - not enough is known about the interrelation between macroscopic and microscopic events concerning the fatigue process, especially in selected titanium alloys. Results from this research study will serve to enhance the understanding about fatigue fracture initiation, propagation and retardation. Objective - this work intends to investigate the specific effects of overload in a systematic study of the different parameters involving retardation of critical-sized linear crack defects. How work contributes - through an extension of scientific information of crack mobility, a better method of design analysis should serve to improve Air Force flight systems reliability and serviceability.

Experimentally, the proposed research will continue to use Ti-6Al-4V as a control standard for crack growth studies with detailed comparisons to other titanium alloys of greater relevance to Air Force needs and priorities, e.g., IMI 685 and 5522S. Appropriate tests are to be made in air and vacuum at temperatures of ambient and about 900 degrees F(482 degrees C).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0006, BALLOON MATERIAL DEVELOPMENT
G.P. DURNEY, I L C Industries Incorporated, *Dover, Delaware* 19901 (DF240050; F19628-73-C-0155)

AF function - advanced balloon systems (surveillance, reconnaissance, communications, environmental research support, space equipment tests, delivery operations). Deficiency - inability to efficiently and economically evaluate strategic and tactical weapon systems and military reconnaissance, communications and satellite systems. Research - balloon materials, tether cables, instrumentation, ground handling equipment and procedures and test flights to extend payload and/or altitude capabilities. How research contributes -research aids in achieving higher altitudes with heavier payloads for long duration, economic evaluation testing of military weapons systems. Improvements in balloon system components increase system performance in areas of altitude, stability, payload weight or duration.

New materials, Kevlar for example, new fabrication techniques, triaxial weave for example, and various coating or laminating designs will be investigated. Various fabric characteristics will be determined by series of laboratory tests in an attempt to find optimum fabric for each part of a balloon. Following this selection, a 45,000 cu ft balloon using the optimum materials will be fabricated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

3.0007, PETROLEUM JET FUEL THERMAL STABILITY
R.N. HAZLETT, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN639147)

To give a chemical rationale to the complex oxidative and pyrolytic degradation reactions of jet aircraft fuels which give undesirable products such as varnishes and gums in fuel system components. Developments arising from these efforts will aid in defining jet fuel composition and suggesting alternate fuel-handling procedures and materials for fuel system components.

The chemical reactions of jet aircraft fuels and hydrocarbon components are being studied in a flowing system which simulates the heat stress in an advanced aircraft fuel system. The main effort is for exposures associated with short times, high temperatures (500-1000 deg F), and air-saturated fuels. The overall chemical reaction schemes are being examined so that the critical oxidative and pyrolytic reactions can be identified and altered. The elemental composition of deposits formed in various devices is also being utilized to define the important fuel reactions.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Propulsion Test Center

3.0008, ENVIRONMENTAL FATE OF HYDRAZINE FUELS
M.J. MACNAUGHTON, U.S. Air Force, Civil & Environ. Eng. Dev. Off, *Panama City, Florida* 32401 (DF408060)

Because of the increased use of the hydrazine family of compounds in rocket fuels and in monopropellant generators it is necessary to understand the chemistry of these compounds in the environment subsequent to their release by spills, venting or incomplete combustion. This data is necessary because of the toxic nature of these fuels and the requirement to assess the environmental effect of their use.

The time-dependent fate of these fuels will be determined in the atmospheric, aquatic and terrestrial phases. The level of minor components which may be significant will also be deter-

mined. Infrared and mass spectral analysis will be used to determine reaction rates and decomposition products.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Civil & Environmental Engineering Development Office

3.0009, KINETICS AND SPECTROSCOPY OF AIRCRAFT AND ROCKET PLUME CONSTITUENTS
F.P. TULLY, Georgia Tech. Research Inst., *Atlanta, Georgia* 30332 (DF049370; F49620-77-C-0111)

AF function - defense, weapons delivery. Deficiency - reaction rate coefficients need to be reliably determined at elevated temperatures for advancement of rocket plume and aircraft combustor technologies. Objective - this work will obtain rate constants for some elementary rate-constants most in doubt in hydrocarbon combustion involving free radicals, and for oxidations of boron halides which may occur in advanced rocket propellant plumes. How work contributes - the results of this research will be used in authoritative AFOSR standard reference kinetic data tables, which in turn will provide development engineers with the required information in such areas as chemical emissions from air-breathing engines (research objective 5.2.6.1) and advanced rocket plumes (research objective 5.1.2).

Flash photolysis followed by laser-induced fluorescence spectroscopy will be used to measure the rate constants of hydroxyl radical reactions with hydrogen, methane, formaldehyde and carbon monoxide in appropriate temperature ranges up to 1200K. The stop-flow time-of-flight mass spectrometry technique will be used to study mechanisms and rate constants of boron halide reactions with oxygen, in a limited temperature range.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0010, INTERACTION AMONG INHOMOGENEITIES 14127-E
T. MURA, Northwestern University, Technological Institute, *Evanston, Illinois* 60201 (DA0E9287; DAAG29 77 G0042)

To study the elastic interactions among inhomogeneities under applied loads and to apply the results to constitutive equations and fracture mechanics. Improvements in fracture mechanics could provide results applicable to helicopter structure design. This method may provide a new approach to cracks under mixed modes and crack branching in composite materials.

A theoretical solution for two ellipsoidal inhomogeneities in an infinite medium under a linear applied stress at infinity will be the starting point. This will be generalized to the case where many ellipsoidal inhomogeneities are present.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

3.0011, LIGHT SCATTERING IN SOLUTIONS OF POLYMERS, MACROMOLECULES, DENSE GASES, LIQUIDS AND LIQUID CRYSTALS
W.H. FLYGARE, Univ. of Illinois, School of Engineering, *Urbana, Illinois* 61801 (DMR76-01058)

These experiments are designed to measure the frequency dependence of the conductivity of ionic conductors such as AgI from D.C. to 100 gHz. By these studies we hope to understand better the mechanism of ionic transport in the solids.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

3.0012, ELECTROPLASTIC EFFECT IN METALS
H. CONRAD, Univ. of Kentucky, School of Engineering, *Lexington, Kentucky* 40506 (DF047130; AF-AFOSR-3203-77)

AF function - Russian scientists have recently reported that plastic deformation of aerospace metals is strongly influenced by impressed electric fields and currents. This research offers a fundamental study of this phenomenological event so that aerospace vehicles, propulsion systems and structural materials might thereby be improved. Opportunity - a scientific explanation of the Russian breakthroughs in this area does not now exist. The opportunity and need for this research is critical for the national engineering community and results are urgently required. Objective - the objective of this work is to characterize the electroplastic effect in aerospace titanium and its alloys. The phenomena are to be interpreted in terms of micromechanics and extended to real systems involving metalworking problems of solid mechanics. How work contributes - part of the AFOSR mission is to provide a scientific understanding for complex engineering or technological problems. This research will serve the interests of the U.S. Air Force by giving solutions to foreign technology problems which are not yet understood.

Experimentally, this proposed research will evaluate the decrease in flow stress during uniaxial deformation at a constant strain rate and the attendant increase in creep rate which occurs upon the application of current pulses of short duration. The mechanical test variables which will be studied include temperature (78 to 1100K) and intermediate strain rates. The electrical variables will include voltage, current, wave form (including D.C. plus A.C. and frequency), number of carriers and pulse duration. Analytically, the program will attempt to interpret the behavior in terms of micromechanics and the interaction of electrons with dislocations. Generally, the data and results will be summarized as to their applicability for improved metalworking methods.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0013, PREPARATION AND CHARACTERIZATION OF INFRARED MATERIALS
A.F. WITT, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF046960; AF-AFOSR-3202-77)

AF function - aerospace communications, surveillance and detection systems require electrooptical devices which exploit the special properties and interactions of infrared radiation with solid-state materials. Opportunity - the far-infrared region of the electromagnetic spectrum has been virtually unexplored for airborne and satellite applications. Sophisticated electrooptical techniques in narrow band-gap compound semiconductors offer promise for electrooptical microcircuitry in the spectral range 10 to 100 micrometers. Objective - the aim of this research is to optimize compositional homogeneity and to control compositional variations in III-V (InSb) and II-VI (CdTe) semiconductor compounds. The goal is to establish quantitative relationships between growth parameters and materials characteristics and to utilize the special properties of these materials for electrooptical device concepts. How work contributes - infrared detectors and tunable infrared sources of coherent radiation require solid-state materials with narrow band gaps, controlled carrier concentrations and doping to provide optimal performance characteristics.

InSb with low doping levels is grown in a modified Czochralski system. Controlled modulation of dopant concentrations over constant growth distances ranging from 50 to 100 micrometers is to be achieved by transmission of appropriate current pulses across the crystal-melt interface during growth. The CdTe is to be grown in a seeded Bridgman-type system making use of the interface demarcation technique, differential heat pipes for effective gradient control and electric current transmission for compositional control in the segregation determining boundary layer at the growth interface. The study of the growth of heavily Bi-doped InSb is to be achieved by a modified Czochralski technique and by a seeded Bridgman technique using a continuous direct electric current to decrease the dopant accumulation in the diffusion boundary layer. All materials are to be quantitatively characterized for compositional distribution, crystalline perfection and subsequently for their specific device performance.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0014, FRACTURE TOUGHNESS EVALUATION OF MEDIUM-STRENGTH STRUCTURAL ALLOYS
C.H. CURLL, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0F4740)

The objective of this program is to be able to characterize the fracture toughness behavior of medium-strength ferrous and nonferrous alloys with the aid of newly developed testing techniques. In this range, the materials are characterized by increased toughness and ductility and, hence, traditional fracture mechanics techniques, such as given in ASTM standard E399, will not apply since plane strain criteria are not met. Emphasis will be placed on high-performance steels, such as ESR 4340, leading to increased realiability and maintainability.

To date, linear elastic fracture toughness characterization has provided failure criterion for a limited class of materials, i.e., those where small-scale yielding has occurred near the crack tip. This effort examines the fracture toughness of medium-strength steels via a j integral technique where large-scale plasticity characterizes the fracture process. It is planned to examine both static and dynamic fracture toughness, the latter to be performed under high strain rates on an impact or drop-weight apparatus instrumented to provide the load history.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Materials & Mechanics Research Center

3.0015, MECHANICAL STUDIES OF COMPOSITE JOINTS

D. OPLINGER, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0D4738)

This effort is relevant to RDT&E thrust G-2 'survivability/aircraft & combat vehicles'. The aim of this work is to provide improved understanding of design requirements of joints in composite structures. Specific attention will be given to effects of layered structure, nonlinear response and failure modes arising at joints. Joint design is a critical factor in achieving performance, lifetime and weight objectives in applications of composites under consideration such as helicopter rotor blades, aircraft fuselage components, man-portable antitank weapons and other fiber-reinforced hardware components. This effort is also relevant to pacing problem no. 22 'design and analysis techniques for fiber-reinforced structures'.

FY76 efforts will include continuation of FY75 analytical and experimental studies of mechanical and adhesive joints with emphasis on confirming analytical predictions related to optimum design of composite joints. Experimental studies will include experimental strain analysis studies (moire and holography) and strength measurement on selected geometric configurations, both in bolted and adhesive bonded joints. Effort will be initiated on application of fracture mechanics approaches to composite joints.

ADDENDA: Supporting agency address is: DARCOM Materials & Mechanics Research Center, Watertown MA 02172

SUPPORTED BY U.S. Dept. of Defense, Army

3.0016, BIAXIAL LOADING OF HIGH-STRENGTH MATERIALS

R.E. PASTERNAK, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0F4691)

Most design data on important engineering alloys is obtained under uniaxial conditions. However, it is difficult from the results of uniaxial deformation to predict materials response under complex loading. Therefore, the objective of this study is to examine factors that influence the behavior of high-strength steel and titanium alloys as well as important ceramic materials under the latter type of loading.

The behavior of high-strength steels and titanium alloys which are candidate torsion bar materials will be optimized under pure shear or torsional loading conditions. The influence of strain rate and repeated strain controlled fatigue loading will be examined. Strain rates will be varied to provide information under static and dynamic (adiabatic shear) conditions, the latter utilizing a specially designed test apparatus. For ceramic materials such as Al sub 2 O sub 3, data previously obtained on the expanded ring test apparatus will be supplemented with data from biaxially loaded cylinders to provide a suitable fracture locus.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Materials & Mechanics Research Center

3.0017, EUTECTOID DECOMPOSITION IN TITANIUM ALLOYS

H.I. AARONSON, Michigan Technological Univ., School of Engineering, *Houghton, Michigan* 49931 (DF038240; AF-AFOSR-2595-74)

AF function - a rational basis for materials development is required to assure the availability and effective utilization of structural materials in future Air Force systems. Opportunity - the fundamental methodology to provide comprehensive and systematic improvement of existing metallic materials and creation of new materials is dependent upon an understanding of the physical metallurgy of alloys. Objective - this investigation will deduce the principles underlying the eutectoid decomposition processes in titanium alloys. How work contributes - understanding of these phase transformations is necessary in order to furnish a more substantial base for the development of useful titanium alloys in which these processes play an important role in determining their microstructure and mechanical properties at room and moderately elevated temperatures.

Specifically, this research will determine why the massive transformation of beta to fully supersaturated alpha occurs in some Ti-x eutectoid systems but not in others, and the ability of the bainite reaction to compete with pearlite formation in hypoeutectoid and eutectoid alloys.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0018, FRETTING FATIGUE AND CORROSION FATIGUE OF METALLIC MATERIALS 12626-MS

D.W. HOEPPNER, Univ. of Missouri, School of Engineering, *Columbia, Missouri* 65201 (DA0F5577; DAAG29 77 G0098)

To discover the fundamental mechanisms of fretting fatigue and corrosion fatigue in single crystals of iron, nickel, and aluminum under various fretting and corrosion conditions. Relevance - failures due to fretting corrosion, corrosion fatigue, and complicated combinations of these have been encountered in components of Army helicopters and engines. The proposed research is directly relevant to such phenomena.

The environments to be examined in corrosion-fatigue and in fretting-corrosion-fatigue include, but will not be restricted to, both gaseous and aqueous media. Other variables to be examined are crystallographic orientation, applied cyclic stress, applied normal load and the material of the fretting couple. The nature of the physical and chemical processes involved in fretting fatigue and corrosion fatigue will be elucidated in order to be able to model the behavior of polycrystals of the same materials under similar conditions. Of special interest are determinations of the kinetics of the failure mechanisms involved.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

3.0019, RESEARCH ON UNSTEADY COMBUSTION PROCESSES

L. CAVENY, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (DF045780; AF-AFOSR-3104-76)

AF function - most advanced Air Force strategic and tactical rocket weapons rely on solid propellants for propulsion. Deficiency - more energetic and reliable propellants are required for future weapons. Objective - this research is aimed at increasing the understanding of the unsteady combustion process which occurs in solid propellants, especially in the areas of velocity coupled instabilities and the burning of aluminum droplets. How work contributes - the understanding gained will permit the design of more reliable high-performance missiles.

This research is divided into two well-separated portions. The first is a combined analytical and experimental effort examining velocity coupling effects in realistic motor configurations. The throat area of laboratory sized, highly loaded motors is reliably oscillated to produce repeatable fluctuations in chamber pressure and velocity. The analysis utilizes experimental results to predict motor behavior where slow gas-phase reactions are important or where metal agglomerates are present. The second portion of the effort studies the behavior of metal agglomerates after they have the surface of a burning propellant with realistic cross flow veloci-

ties. High-speed photographic techniques are employed in the latter effort to provide insight into the burning metal behavior.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0020, STRUCTURE AND CHEMISTRY OF SURFACES
R.P. MERRILL, Cornell University, Graduate School, *Ithaca, New York* 14850 (DF049610; F49620-77-C-0118)

AF function - propulsion and power generation systems for future AF weapon systems may depend upon synthetic fuels and surface-induced combustion. Heterogeneous catalysis is an essential element for the synthesis of fuels and for the decomposition of propellants used to generate power and/or thrust. Deficiency - physical degradation of catalyst particles in monopropellant thrustors has become a limiting factor in engine life. Objective - this research has two major objectives. One is directed toward the theoretical and experimental studies of oxidation and hydrazine decompositions occurring on noble metal surfaces such as iridium. An equally important and collateral objective is to understand how oxide layers on aluminum and titanium surfaces withstand corrosive attack. How work contributes - hopefully better catalysts with longer lifetimes can be developed if enough is known about the basic surface chemistry of the catalytic process. Also improved inhibitor systems can be found to protect components and aircraft structural metal surfaces from corrosion damage.

An elaborate ultra-high vacuum scattering chamber will be used to make precise measurements of surface composition and structure, both atomic and electronic. The apparatus is sufficiently versatile to permit analysis by electron spectroscopy, LEED intensity measurements and both elastic helium scattering and reactive surface scattering techniques. Specific studies will be made of oxide layers on titanium and aluminum surfaces, the decomposition of hydrazine on iridium catalyst and selected oxidation reactions on platinum.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0021, GROWTH AMD PROPERTIES OF INP
J.K. KENNEDY, U.S. Air Force, Rome Air Development Ctr., *Rome, New York* 13440 (DF902880)

AF function - integrated optics and signal processing. Deficiency - materials deficiencies in integrated optics and signal processing devices. Objective - to determine the preparation and growth parameters necessary to produce high-quality bulk single crystals of InP and other III-V's for use as substrates for device fabrication. How research contributes - indium phosphide has great potential for the Air Force as a substrate material both for integrated optical communication systems and signal processing systems. The potential of test devices has already been demonstrated; however, the high cost, poor quality and lack of reproducibility and reliability of the indium phosphide substrates are a major roadblock to the successful exploitation of this material.

Most of the commercially available indium phosphide single crystals are grown in Great Britain although one domestic vendor started supplying in limited quantities earlier this year. The cost of this material is very high and the quality varies appreciably from batch to batch. To supply our in-house device fabrication needs we intend: (1) to investigate and develop a synthesis procedure for the preparation of high-quality polycrystalline indium phosphide, (2) to use the polycrystalline indium phosphide prepared in (1) to grow high-quality undoped, n-type p-type, and semi-insulating indium phosphide single crystals using the liquid encapsulation technique.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

3.0022, FUNDAMENTAL STUDY - ELECTROMAGNETIC PROPERTIES OF ADVANCED COMPOSITE MATERIALS
B. STRAIT, Syracuse University, School of Engineering, *Syracuse, New York* 13210 (DF737220; F30602-75-C-0121)

The objective of this effort is to have a better understanding of the fundamental mechanisms controlling the electromagnetic properties of advanced composite materials with the ultimate aim of being able to tailor these properties to fit the needs of the mission without an accompanying change in the mechanical properties and density.

This information will be obtained through a subcontract with University of Notre Dame supported by an in-house effort. Technically, this will involve an investigation of the conduction mechanism in the components of composite materials, the interaction of these mechanisms in the finished composite, and an examination of ways in which the properties change or can be changed (e.g., by impurities, doping).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

3.0023, EFFECT OF BONDING CHARACTERISTICS ON METAL MATRIX COMPOSITE PROPERTIES
R.G. CARLSON, General Electric Company, *Cincinnati, Ohio* 45215 (DF047990; F49620-77-C-0067)

AF function - Air Force propulsion systems of the future are expected to contain metal matrix composites because of their attractive mechanical properties at substantially reduced weight. Opportunity -however, a better technical understanding is required for design and application of this class of materials. In addition, this understanding is anticipated to provide for improved impact-resistant materials for fan and compressor blades, and to allow for lower cost processing and fabrication of metal matrix composites. Objective - this research will develop an understanding of the metal matrix composites to effect a balanced increased in mechanical properties, placing specific emphasis on increased impact resistance. How work contributes - this technology can then be translated into composite systems in general, including resin matrix composites, and lead to more extensive application of composite materials to aircraft propulsion systems.

This program is directed toward understanding the basic bonding mechanisms of metal matrix composites, specifically between boron filaments and an aluminum matrix. The effort consists of three tasks -(1) surface preparation and characterization of single sandwich panels incorporating both aluminum and boron surface treatments, (2) upon extraction of correlative data, larger 8-ply panels will be selected and fabricated, and scrutinized by nondestructive evaluation, (3) the larger panels will be sectioned, and selected mechanical and physical properties will be evaluated in order to ascertain generic coupling/property behavior.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0024, MATERIALS SUPPORT TECHNOLOGY - EFFECT OF RARE-EARTH ADDITIONS ON MECHANICAL PROPERTIES OF HIGH-STRENGTH STEEL
C.S. KORTOVICH, Thompson Ramo Wooldridge Inc., *Cleveland, Ohio* 44117 (DN475430; N00014-74-C-0365)

The objective of this research is to determine if rare-earth additions are beneficial to the mechanical properties of high-strength steels used in naval aircraft structures.

Alloying additions of the rare earths lanthanum and cerium are to be made to high-strength steels. The effect of these additions on microstructure, workability, and mechanical properties is to be determined by standard metallurgical techniques.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0025, FATIGUE CRACK PROPAGATION IN POLYMERIC MATERIALS 14409-MS
R.W. HERTZBERG, Lehigh University, School of Engin. & Phys. Sci., *Bethlehem, Pennsylvania* 18015 (DA0E9233; DAAG29 76 G0336)

To study (a) the relative fatigue crack propagation (FCP) frequency sensitivity of polymers over a range of temperatures; (b) the effect of molecular weight and molecular weight distribution on FCP behavior in polymers; (c) the kinetics and micromechanisms of cyclically induced craze and crack growth in

polymeric solids. Relevance - the research is relevant to a number of Army problems in flight vehicles (e.g., in windshields, airframe structures, etc.) and to a wide range of structural and nonstructural Army applications where plastics and polymer-based composites are coming into usage as substitutes for metals and alloys because of lighter weight, cost savings, and other factors.

FCP frequency sensitivity will be studied with the aid of transition measurements (related to segmental molecular motions). Frequency sensitivity and propensity for discontinuous crack extension will be examined as a function of molecular weight and molecular weight distribution. Electron fractography would be employed in studies of crack morphology and to assist in identification of the micromechanisms underlying crack growth.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

3.0026, MECHANISTIC BEHAVIORAL STUDIES OF WELDED STRUCTURAL STEEL UNDER STRESS CORROSION ENVIRONMENTAL EFFECTS

V. DAMIANO, Franklin Inst. of State of Pa., *Philadelphia, Pennsylvania* 19103 (DF048780; AF-AFOSR-3341-77)

AF function - Air Force flight vehicles are fabricated using complex, mixed materials that each exhibit different reactions to environmental effects. In order to improve the serviceability of Air Force vehicles, research should now be done to better understand the role of selected environs during the phenomenalistic problem of stress corrosion. Opportunity - the combined effects of stress and corrosion on the loss of ductility and stiffness for exploratory Air Force steels is an unknown area that requires scientific exploitation. For example, the stress corrosion behavior of AF-1410 steel has not been properly evaluated and the problem is of real concern to airplane designers for the long term. Research in this area would provide much-needed answers to questions that are vital to the life cycle service of aerospace structures fabricated of AF-1410 steel. Objective - this proposed work is to compare the stress corrosion susceptibility of AF-1410 parent material, heat-affected zones and weldments in both aqueous and gaseous environments using a fracture mechanistic approach. How work contributes - the research would contribute to the AFOSR mission in the area of a continuing effort on problems relating to fatigue, fracture and environmental effects in the field of structural materials mechanics.

Experimentally this program will consider these variables of stress corrosion - sample location and condition, aqueous and gaseous susceptibility, method of testing, welding variables and cathodic polarization. Analytically, the data will be characterized using fractography and in situ stress corrosion cracking observations so that models may be developed to predict, prevent and control the problem of stress corrosion.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

3.0027, NAVY VEHICLE DESIGN AND CONSTRUCTION - ELONGATION AND ITS RELATIONSHIP TO RESIDUAL STRESSES IN BORON FILAMENTS

F.E. WAWNER, Univ. of Virginia, School of Engin. & Appl. Sci., *Charlottesville, Virginia* 22903 (DN675404; N00014-76-C-0694)

Composite materials are seeing increased use on aircraft and other high-performance vehicles due to their specific weight and stiffness. This investigator will examine the phenomenon of elongation in boron filaments in an effort to enhance the production rate and thereby reduce the cost of this high-strength, high-stiffness reinforcement.

Boron filaments will be produced in a static reactor with controlled variables of temperature, gas composition, flow rate, substrate type and applied tension. Residual stresses present in the filaments, filament elongation, and filament mechanical properties will be measured. Results should indicate desired conditions for boron growth in a commercial continuous reactor. This will be explored in the later stages of the research.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0028, NAVY VEHICLE DESIGN AND CONSTRUCTION - FRACTURE OF METALS AND ALLOYS

H.G. WILSDORF, Univ. of Virginia, School of Engin. & Appl. Sci., *Charlottesville, Virginia* 22903 (DN023110; N00014-75-C-0855)

The goal of this research is to gain a better understanding of crack propagation and fracture processes occurring in metals and alloys. This knowledge will be useful in the development of reliable, crack-resistant alloys needed in advanced naval systems such as high-performance aircraft and deep-diving submarines.

Crack propagation and fracture of various metals and alloys are being observed directly in a 500KV electron microscope. This allows dislocation interactions and fracture processes to be observed on a near-atomic scale in specimens which exhibit bulk rather than thin-film behavior. Correlation of experimental observation with theoretical fracture analyses is being undertaken.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

3.0029, SYNTHESIS AND SPECTROSCOPIC INVESTIGATION OF INORGANIC MATERIALS POSSESSING UNUSUAL ELECTRONIC PROPERTIES

G.A. CROSBY, Washington State University, School of Arts & Sciences, *Pullman, Washington* 99163 (DF042400; AF-AFOSR-2932-76)

AF function - advanced aircraft employ avionic and weapons systems with increased performance requirements. Deficiency - functional componenets for electromagnetic and electrooptical systems require materials with tailorable and predictable properties. Objective - the objective of this research is to utilize transition metal complexes and their charge-transfer excited states in solids to guide the design of new electronic materials. How work contributes - highly specialized materials could result in significant performance improvement in Air Force electronic displays, nonlinear optics, electrooptical devices, and laser systems.

The research encompasses chemical synthesis, optical absorption, emission and reflectance measurements, and the determination of the effects of external magnetic fields on excited solid-state properties of complementary inorganic complexes whose electronic structures suggest the incidence of strong solid-state interactions where the units are incorporated with solids. These include complexes of D-6, D-8 and D-10 ions from all the transition series with emphasis on those whose low-lying excited states are charge transfer in nature and those with high electronic affinities. Special emphasis is placed on mixed-ligand materials and sulfur coordination. There will be increased emphasis on measurements at low temperatures as the role of isolated systems in solid-state interactions becomes defined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, ANALYSIS OF FREE-FLIGHT ROCKET LAUNCHER DESIGN CRITERIA

J.E. COCHRAN, Auburn University, Engineering Experiment Station, *Auburn, Alabama* 36830 (DA0F1352; TO BE DETERMINED)

To develop methods to estimate free-flight rocket systems impact dispersions. These methods will couple the launch-phase errors to the free-flight errors in a manner usable by design engineers. Effects of rocket flexibility on the launch-phase errors will be defined.

Models previously developed by Auburn University will be exercised, expanded and utilized to determine the causes and effects of launch phase errors on impact dispersions. Current models include rocket thrust misalignment and dynamic unbalance effects. The expanded models will include effects of rocket bending or flexibility on launch phase errors. The complex

models will be simplified, while retaining the more significant errors sources, to a form readily usable by design engineers.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Ground Equipment & Materials Directorate

4.0002, FLOW FIELD COMPUTATIONAL METHODS FOR MISSILE LAUNCH AND TRANSONIC FLOW
B.Z. JENKINS, U.S. Army, Radar Technology Laboratory, *Huntsville, Alabama* 35809 (DA0F1353)

To provide the capability for predicting the flow phenomena affecting missile launch and initial flight behavior up through transonic speeds.

Acquisition and development of analytical flow field prediction techniques and experimental verification of their accuracy and limitations will continue. Effort will be concentrated on overcoming difficulties caused by low-speed near-launch flow irregularities and in extending the increasingly important capability to simulate flow fields with significant compressibility effects.

SUPPORTED BY U.S. Dept. of Defense, Missile Research & Development Command, Aeroballistics Directorate

4.0003, EFFECTS OF HIGH-LATITUDE GEOPHYSICAL EVENTS ON VHF AERONAUTICAL NAVIGATION AIDS
H.F. BATES, Univ. of Alaska, Geophysical Institute, *Fairbanks, Alaska* 99701

ATMOSPHERE - To study the effects of auroral and related disturbances phenomena on navigational aids for commercial and other aircraft.

SUPPORTED BY U.S. Dept. of Transportation, Unspecified Unit

4.0004, GENERATION OF A CONJUGATE WAVE FROM A WEAK SIGNAL
F.A. HOPF, Univ. of Arizona, Optical Science Center, *Tucson, Arizona* 85721 (DF044660; AF-AFOSR-3079-76)

AF function - the University of Arizona has proposed a concept that could have tremendous impact on adaptive optics approaches for Air Force laser systems. These currently involve scanning detectors, interferometers, computers, servosystems and deformable mirrors. All of this hardware could be replaced by a nonlinear element at low power if the optical parametric oscillator idea as proposed works. Opportunity -certain parametric oscillator processes may be able to generate an output optical beam (idler) which has conjugate phase from that of the input beam (signal), and has the same frequency as the signal beam, if one uses a pump which is the second harmonic of the signal. This is called a degenerate parametric oscillator. The important point is that if a laser beam is propagated through an atmosphere and reflected back to the receiver, then it will be subjected to an aberration by the optical path it traversed. If this aberrated return is used as the signal into the parametric oscillator, then the idler output from the parametric process should be phase conjugate of the aberration. This then could be injected into a high-power laser and phase locked so that the laser generates a beam at high power with conjugate phase of the optical aberrations in the optical path. Objective - to demonstrate 'proof-of-principle' in the visible using existing nonlinear crystals. Contributions - this work provides an alternative to the adaptive optics approach to correcting distortions.

Promising crystal candidates are lithium sulfate and lithium formate at a wavelength of 0.95 micrometers. It is proposed to modify a YAg laser at Arizona to operate at 0.95 micrometers and, assuming these materials can be phase matched, carry out a demonstration of the concept. The preliminary steps will require data on the wavelength and temperature dependence of the indices to confirm the feasibility of phase matching. A preliminary investigation can also be done at 1.06 micrometers where the phase match angle for lithium formate is 82 degrees (rather than the ideal 90 degrees). At that angle the walk-off angle is 0.007 radians, which gives lateral motion of 0.07 mm over a 1 cm length. This will be sufficiently small so that preliminary (one dimension) verification of the principle is possible.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0005, IDENTIFICATION OF FLAWS IN HIGH-PERFORMANCE CERAMICS
G.H. SINES, Univ. of California, School of Engin. & Appl. Sci., *Los Angeles, California* 90024 (DF049820; AF-AFOSR-3425-77)

AF function - ceramic electromagnetic windows for radar and target acquisition allow combat aircraft to operate in all weather conditions. Deficiency - ceramic windows are, however, subject to brittle fracture originating from preexisting defects. Objective - the objective of this research is to identify the source and character of the defects which lead to mechanical failure in ceramic components. How work contributes -identification of the sources of failure is necessary in order to design nondestructive evaluation (NDE) techniques to find and reject components having unacceptable preexisting defects.

An eccentrically loaded column bend test will be developed to enable a number of small cracks (equivalent to 20) to grow without catastrophic failure occurring from just one worst flaw. The selective nature of slow crack growth from certain categories of flaws will be determined. New techniques which permit the identification of many flaws (greater than 10 to the 4) from the study of microspallation of a single compressively loaded specimen will be correlated with tensile fracture initiation sites.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0006, RESEARCH ON WALL TURBULENCE 13681-E
R.F. BLACKWELDER, Univ. of Southern California, School of Engineering, *Los Angeles, California* 90007 (DA0E9203; DAAG29 76 G0297)

To experimentally explore the unsteady eddies that occur naturally in turbulent shear flows. Relevance - new turbulence models are needed for prediction methodology in missile aerodynamics, rotorcraft aerodynamics and interior and exterior ballistics.

Special techniques will be developed to cope with the random phase which occurs whenever detecting and sampling occur at different spatial locations. The relationships between turbulent bursts and the outer flow field will be examined and the downstream evolution of the bursting phenomena will be investigated utilizing these specialized techniques.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0007, GRADIENT FREEZE GROWTH OF INP
W.P. ALLRED, Crystal Specialties Inc., *Monrovia, California* 91016 (DF903010; F19628-77-C-0105)

AF function - signal processing and integrated optics for communications systems. Deficiency/opportunity - indium phosphide crystals for use as substrates for integrated optics and signal processing devices are of dubious quality, in short supply and very costly. Objective - to develop a growth system for and to grow high-quality, low-cost, single crystals of indium phosphide. How research contributes - single-crystal indium phosphide is an extremely promising material for use as substrates for integrated optics, signal processing, and microwave devices. One of the major deterrents to the development of such devices is the limited availability and very high cost of high-quality substrate material. Successful completion of the effort outlined in this contractual effort should eliminate these deficiencies.

A high-pressure gradient-freeze crystal growth system will be fabricated. The influence of synthesis, growth and material parameters on the growth and perfection of grown crystals will be investigated. N-type, p-type, undoped, and semi-insulating single crystals of indium phosphide will be grown.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0008, SEPARATED FLOWS, TURBULENCE PRODUCTION MECHANISMS AND FREE SHEAR LAYERS
S.J. KLINE, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DF037770; F44620-74-C-0016)

Air Force function - advanced air-breathing propulsion devices -aerospace vehicles. Deficiency - prediction methods for turbulent shear flows are inadequate. Objective - increased understanding of the basic flow structure and computational ability for turbulent shear flows, for their interaction with regions of 'inviscid' flow, and their stability with regard to such interactions. How work contributes - improvement in both physical understanding and prediction ability will permit better design of any system (jet engines, turbine blades, diffusers, airfoil sections) in which these flows become limiting or controlling factors.

A combined experimental and theoretical program has been established. On the theoretical side the first priority will be the improvement and extension of the methods for computing separated flows. The experimental program will provide needed data to aid in modeling this critical area. In addition, an experimental and theoretical study of separated flows with reattachment will continue.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0009, AN INVESTIGATION OF THE RELIABILITY EVALUATION OF COMPUTER SYSTEMS
E.J. MCCLUSKEY, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DF04764C; AF-AFOSR-3325-77)

AF function - the design of digital avionics systems. Important functions in growing numbers are being performed by digital systems on USAF aircraft. The consequent demands for reliable computing require newer and better designs in electronic circuitry. Deficiency - the correct functioning of the computer system is crucial since malfunctions could have catastrophic consequences for an aircraft. Such ultra-reliable computers are not yet available. Objective - to develop general tools and unified principles and methods for evaluating the reliability of competing possibilities in the design of computer circuits so that the best system configuration can be chosen for the required application. How work contributes - the results of this research, if successful, would permit the construction of ultra-reliable computers which are essential for advanced technology aerospace vehicles.

The research will be performed in three concurrent efforts, viz., analytic modeling (applying mathematical probability theory), simulation, and experimentation with actual prototype fault-tolerant computers such as the NASA dual computer system.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0010, THE DEVELOPMENT AND APPLICATION OF NOVEL METHODS FOR THE SOLUTION OF EMP SHIELDING PROBLEMS
C.H. PAPAS, Calif. Inst. of Technology, School of Engineering, *Pasadena, California* 91109 (DF050080; AF-AFOSR-3451-77)

AF function - nuclear detonations emit a short pulse of electromagnetic radiation (EMP) which may damage unprotected electrical systems when incident upon aircraft. To shield such systems an understanding of the penetration of radiation through apertures is required. Deficiency - the penetration of electromagnetic radiation through apertures in structures with complex geometries is unknown. This program will employ novel methods to obtain upper and lower bounds on this penetration. Objective - the objective of this research is to apply the theory of knots, the theory of braids and the theory of isoperimetric inequalities to obtain estimates, on the basis of geometrical data alone, of the penetration of electromagnetic radiation through apertures in bodies with complex configurations. Contribution -this study will provide important useful engineering tools.

The use of isoperimetric inequalities has been successfully applied in the symmetrization of a problem in EMP shielding. Further use of this method and other geometric notions of pure mathematics will be employed to solve EMP shielding problems having complex geometries. The utility of mathematical notions such as those contained in the theory of knots and braids will be investigated in attempts to obtain estimates of the penetration of radiation through apertures in aircraft.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0011, EXPERIMENTAL STUDY OF THE CHARACTERISTIC PROPERTIES OF VARIOUS TURBULENT SHEAR FLOWS ENCOUNTERED IN SYSTEMS OF NAVAL INTEREST
A. ROSHKO, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DN623976; N00014-76-C-0260)

Since the flows over all naval ships and airplanes are largely turbulent, measurements which lead to a better understanding of such flows could result in significant improvements in the performance of naval craft. This experimental task will obtain data to develop phenomenological laws to predict the effects of density differences and pressure gradient on the turbulent processes so that reliable engineering estimates are available for design.

Experimental investigations will continue on the problem of describing characteristic, coherent structures in turbulent shear flows, with emphasis on turbulent wakes. The role of the peculiar properties of superfluid helium in turbulent flows will also be studied.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0012, THIN-FILM OPTICAL DEVICES AND QUANTUM ELECTRONICS
A. YARIV, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DF041480; AF-AFOSR-2874-76)

AF function - fiber optics and thin-film integrated optical circuits offer promise of avionic system miniaturization, cost reduction, and band-width extension of significant proportions. Opportunity - one goal is to transmit optical information along an optical fiber purely optically without converting optical signals into electrical signals as presently planned. The other goal is to demonstrate integrated optic devices based on employing thin film gratings with variable periodicities. Objective - to investigate a holographic compensation technique which will correct for phase distortion in the direct transmission of optical images in optical fibers. To correlate theoretically and experimentally the properties of thin film gratings with variable periodicities and useful optical device functions. How work contributes - success in the objectives will lead to devices useful for optical communication systems.

The relative importance of two mechanisms which hinder the correction of the phase distortion in optical fiber transmission is to be investigated - coupling of eigenmodes of an ideal fiber due to fiber imperfections and the overlap of fiber eigenmodes in the process of a Fourier transformation involved in the holographic technique. Thin film gratings with variable periodicities are to be studied for multiplexing, demultiplexing, and broadband filtering.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0013, TIME-DEPENDENT FINITE-DIFFERENCE SOLUTIONS FOR UNSTEADY TRANSONIC FLOW
H. YOSHIHARA, General Dynamics Corporation, *San Diego, California* 92138 (DF136000; F33615-76-C-3018)

High-speed military aircraft require extensive transonic wind tunnel testing to establish flutter flight-safety. Wind tunnel testing has been necessary because transonic unsteady aerodynamic methods have not been available for flutter analysis. The purpose of this program is to use the time-dependent finite-difference analogue of the exact planar inviscid and adiabatic flow equations to generate a number of significant unsteady transonic flows that can serve as a validation basis for simpler procedures more amenable for practical usage, such as in transonic flutter analysis. This effort augments the work under work unit 13700402 which is also transonic unsteady aerodynamics, but is restricted to stationary shock waves. Cost savings in development will occur because some transonic wind tunnel testing will be supplanted by analysis. Operational cost savings will occur because aeroelastic

optimization of aircraft designs will be available for the first time at transonic speeds, leading to reduced weights, greater performance, and greater efficiency of flight.

The contractor will evaluate and implement promising methods to improve efficiency and computing speed of the time-dependent finite-difference method. The contractor will use the improved method to simulate wind tunnel tests of two-dimensional airfoils in unsteady transonic flow. The improved method will also be used to calculate the transient response of an airfoil near a flutter condition composed of rigid airfoil pitch and plunge.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

4.0014, VEHICLE DESIGN AND CONSTRUCTION - ANALYTIC PROCEDURES FOR SYNTHESIS OF NON-LINEAR STOCHASTIC FEEDBACK CONTROL

G. MICHAEL, United Technologies Corp., *Hartford, Connecticut* 06108 (DN675331; N00014-76-C-0710)

The objective of this research is to define, develop, and evaluate analytical synthesis procedures for multivariable feedback control of nonlinear dynamic systems operated upon by random disturbances. Such system capabilities are needed to facilitate the development of aircraft flight control systems for prevention of spin departure during combat maneuvering, improve ability to maintain desired glide slope during carrier landings, precision hover/landing control for Navy V/STOL aircraft, as well as enhanced guidance and control capabilities for tactical missiles.

The approach is based upon separating the stochastic and deterministic aspects of the control problem. This results in a three-part approach to stochastic system control design: (1) deterministic nonlinear feedback control using piecewise-linear/piecewise-optimal (PLPO) procedures, (2) nonlinear stochastic estimator design, and (3) closed-loop control based upon feedback of estimated system state variables through the PLPO control logic. This research focuses on feedback of estimated engine variables through multivariable control logic. Program objectives are directed toward demonstrating rapid closed-loop propulsion system response which will be required for Navy V/STOL A and B aircraft applications.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0015, HIGH-LATITUDE D-REGION IONOSOUNDING

N.V. JENSEN, Danish Meteorological Inst., *Lyngby, Denmark* (DF900130; AF-AFOSR-2597-74)

AF function - navigation and survivable communications. Deficiency - communications interference from natural and nuclear ionospheric disturbances. Objective - employ high-resolution techniques to measure arctic propagation stability under normal and disturbed ionospheric conditions. How research contributes - provides the experimental information required for interpreting and modeling VLF/LF propagation.

The propagation reliability of these frequencies is based on theoretical modeling for which there is only limited quantative data, particularly for disturbed conditions. As the lower ionosphere is severely disturbed during polar cap absorption events, which occur occasionally at high latitudes, a unique opportunity is provided to investigate propagation effects. To observe this phenomenon, AFCRL's VLF/LF ionosounder was moved to Greenland with the transmitter at Thule Air Base and the receiver at the Danish Meteorological Institute's Ionospheric Observatory in Qanaq, Greenland. Through this research grant the receiver will be installed and operated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0016, NAVIGATION - STELLAR BINARY SYSTEMS FOR INCREASED POSITIONAL ACCURACY

C.E. WORLEY, U.S. Navy, Observatory, *Washington, District of Columbia* 20390 (DN046005)

Observations of binary stars provide correctional input to fundamental star catalogs and to star lists for navigational purposes.

Observations are carried out both visually and photographically with a 26-inch refractor and a 24-inch reflector at Washington and with the 61-inch and 40-inch reflectors at Flagstaff, Arizona. The photographic observations are measured with the high-precision measuring machines at the observatory.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Observatory

4.0017, AUTOMATIC CORRELATION MEASUREMENT EXPERIMENT

F. ROTZ, Harris Corporation, *Melbourne, Florida* (DF712010; F30602-76-C-0381)

The objective of this effort is to provide an automatic experimental output measurement breadboard device to read-out parallax data in near real-time and to investigate CID, CCD, or TV raster scanner technique for improving the resolution, accuracy, and speed requirements necessary for the near real-time read-out of correlation peak locations in the output plane of the optical system.

Various tasks will be undertaken to provide for the automatic experimental correlation measurement breadboard device: 1. Evaluation sensors, such as CID, CCD, and TV compatible scanners, to determine the best methodology to increase the position detector about the correlation peak. 2. Evaluate the accuracy of the amplitude information obtained to determine the parameters for the design of the experimental position detector. 3. Include necessary instrumentation to allow for automatic collection of correlation data from real stereo models and evaluate the system performance of the automatic experimental correlation measurement breadboard device.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0018, FLAME EFFICIENCY, STABILIZATION AND PERFORMANCE IN PREVAPORIZING/PREMIXING COMBUSTORS

A.M. MELLOR, Purdue University, School of Mechanical Engin., *Lafayette, Indiana* 47907 (DF042560; AF-AFOSR-2936-76)

AF function - advanced air-breathing engines, airborne weapon delivery and defense, transport. Deficiency - insufficient fundamental understanding of the problems associated with high-speed reacting flows in advanced high-temperature, high-pressure air-breathing combustors and lack of realistic guidelines for predicting combustor/propulsion system performance and operational characteristics. Objective - to formulate realistic analytical representation of the mechanisms and processes associated with combustor stability limits, i.e., pre-ignition, flashback and blowoff and exhaust gas pollutant and plume formation in advanced turbojet and ramjet combustor concepts, e.g., catalytic, vortex and rapid expansion, incorporating fuel-air premixing and prevaporizing. How work contributes - will provide additional understanding and realistic analytical modeling of the fundamental mechanisms responsible for pre-ignition, flashback and blowoff phenomena not now available and will contribute to establishing guidelines and techniques for improving combustion stability and performance and obtaining of acceptable exhaust pollutant and plume characteristics of advanced turbojet main and afterburner and ramjet combustion systems.

Flashback and blowoff phenomena associated with premixing/prevaporizing combustion systems will be studied, e.g., rapid expansion catalytic burners. A sudden expansion combustor modeling aspects of continuous flow turbojet combustors, afterburners, and ramjet combustors will be mounted in air facility capable of simulating the inlet conditions representative of advanced engines. Experimental determinations of combustion efficiency and flame stabilization (flashback and blowoff) limits will be made, and concentration and temperature measurements will be obtained within the combustor for analytical model development. The program will initially concentrate on obtaining time-averaged data by movable single point probes and stationary exhaust plane rakes. Analysis of the data will include extension of stabilization correlations to the inlet Reynolds number, temperature and pressure ranges, as well as to practical aviation fuel types used in modern engines. Subsequent effort will be devoted to more complicated combustor geometries and more refined

analytical modeling and analysis. Also, more sophisticated laser combustion diagnostics will be utilized to supplant the time-averaged measurements.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0019, COHERENT STRUCTURE OF A TURBULENT BOUNDARY LAYER

C.R. SMITH, Purdue University, Purdue Research Foundation, *Lafayette, Indiana* 47907 (DF043850; F44620-76-C-0099)

AF function - advanced aerospace vehicles. Opportunity - develop a better understanding of the behavior of turbulent flows. Objective - to develop a better understanding of turbulent boundary layer structure and its iterative behavior. How work contributes - the information to be obtained from this research is necessary both in the development of improved methods for turbulent boundary-layer control and for the development of improved a priori analytical prediction techniques for turbulent boundary-layer flows.

The research will be a detailed multi-phase experimental study of the quasi-ordered flow structure of a turbulent boundary layer. In phase one, the characteristics of the large-scale transverse-vortex structure associated with turbulent boundary layers and the interactive effect it has on the wall-layer structure will be determined. In phase two, pointwise measurements via hot film and hot wire anemometers will be accomplished. The third phase will be to develop a mathematical model of the traveling structure. Finally, in phase four, detailed measurements will be made in both a water tunnel and wind tunnel, thus providing a direct mechanism for correlation of the physical structure and behavior of turbulence with traditionally measured properties.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0020, HIGH-ANGLE-OF-ATTACK SUPPORT INTERFERENCE

R.C. NELSON, Univ. of Notre Dame, Graduate School, *Notre Dame, Indiana* 46556 (DF048370; AF-AFOSR-3297-77)

AF function - advanced aerospace vehicles. Opportunity -improvement in ability to perform aerodynamic testing of missile configurations. Objective - experimentally investigate the influence of the sting or strut support system on the flow field around slender bodies of revolution at large angles of attack. How work contributes -will provide data useful for designing improved support systems which minimize model-support interference.

The interference of the sting and strut supports will be examined by means of two experiments. In the first experiment the influence of a wake splitter plate (strut support) on the flow around a two-dimensional cylinder will be studied. In the second experiment the flow around a semi-infinite cylinder with and without the presence of a sting will be studied. Analyses of this data will provide insight into the flow field interference created by a model support system.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0021, FINITE ELEMENTS FOR FLUID DYNAMICS

N. GEFFEN, Tel Aviv University, *Ramat Aviv, Tel Aviv, Israel* (DF048990; AF-AFOSR-3345-77)

AF function - aerospace vehicles. Opportunity - both present and future Air Force aerospace vehicles will be required to fly at high speeds and have an ability to maneuver at all speeds. This will require that new and improved engineering design and analysis methods be developed throughout the total speed regime for the precise engineering determination of the performance and system capabilities of these vehicles. Objective - this research will attempt to develop new methods for fluid dynamical analysis using high-speed computers, methods which circumvent the disadvantages of currently employed machine algorithms. How work contributes - the ability to perform aerodynamic calculations about complex (real) shapes using finite-element methods which are becoming standard in structural analysis could lead to great improvements in efficient use of computers as engineering design and analysis tools. Resolutions of the variational problems underlying the use of such finite elements will do much to bolster engineering confidence in the (numerical) finite-element methods, thereby giving the engineer an added and vital tool for use in predicting the 'grand ensemble' vehicle flow field.

This research will investigate the possibility and feasibility of using variational formulations to obtain finite-element analysis and procedures for the solution of quasilinear hyperbolic and mixed initial value problems, with application to unsteady flow about bodies, time-dependent simulation of aerodynamic phenomena in all speed ranges, steady transonic flows (including the case of the supercritical wing) and to internal gasdynamic flows (e.g., cascades and inlets).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0022, APPLICATION OF FUNCTIONAL ANALYSIS IN FLUID MECHANICS

L. NAPOLITANO, Univ. of Naples, *Naples, Italy* 80100 (DF041730; AF-AFOSR-2889-76)

AF function - aerospace vehicles. Opportunity - future Air Force aerospace vehicles will be required to fly at high speeds and have an ability to maneuver at these speeds with increased efficiency. This will require that new and improved engineering design and analysis methods be developed throughout the total regime for the precise engineering determination of the performance and system capabilities of those vehicles. Objective - this research will attempt to develop new methods for fluid dynamical analysis using high-speed computers, methods which should circumvent the disadvantages of currently employed machine algorithms. How work contributes - the great success of the finite-element method in solid mechanics offers tempting possibilities to extend its application to fluid mechanics as well. The potential power of the application of finite-element techniques to fluid mechanical problems will require the application of functional analysis to unify the many treatments in the literature.

This research will systematically apply functional analysis to the development of finite-element techniques for the solution of fluid mechanical problems, thereby unifying the many treatments in the literature that now appear superficially different and framing into a clearly defined context the problems and questions that still remain to be resolved before finite-element methods can be employed rigorously and economically in fluid mechanical analysis.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0023, FATIGUE IN ADHESIVELY BONDED LAMINATES

J.A. ALIC, Wichita State University, School of Engineering, *Wichita, Kansas* 67208 (DF043490; AF-AFOSR-2994-76)

AF function - advance Air Force flight vehicle structures require designs of increased efficiency and durability. Adhesively bonded primary structure is one avenue to achieve new performance goals. Opportunity - improved understanding of the fatigue behavior of aluminum bonded structures could significantly aid in increasing aircraft durability. Objective - the objective of this research is to improve our knowledge of the fatigue behavior of bonded structure. How work contributes - the research contributes to the overall structures technology goal of developing improved structural performance with adhesive bonding.

This research will experimentally study tension-tension fatigue of bonded laminates. 7075 and 2024 aluminum will be used in the experiments. Both thick and thin laminae will be used in constructing specimens. Specimens of unnotched and notched configuration will be used in the study of crack initiation and crack propagation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0024, AERODYNAMIC HEATING OF CONVENTIONAL WEAPONS

D. MAPLES, Louisiana State Univ. Systems, School of Engineering, *Baton Rouge, Louisiana* 70803 (DF047840; AF-AFOSR-3250-77)

AF function - aerodynamic heating of external stores is an Air Force problem with high-performance aircraft. It has been specifically identified as such in AFATL TPO-8. Deficiency - research is needed to better quantify the limitations of existing stores and to provide research alternatives to these stores where critical to performance. Objective - to conduct basic research in aerodynamic heating of conventional weapons with ultimate goals of quantifying the phenomena and providing research alternatives to existing limitations. A subsidiary objective is to design and help establish a suitable research laboratory at AFATL with completion in FY 79. How research contributes -the research will provide a basic understanding of aerodynamic heating effects on conventional weapons, through which the deficiency can be reduced or eliminated. The research contributes to RO 4.2.11 and RO 6.2.5.

The facility will be used to experimentally investigate the problem, and research will be conducted to improve the state-of-the-art in thermal scale modeling.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0025, FLIGHT DYNAMICS--RESEARCH IN AERODYNAMICS--RESEARCH IN BALLISTICS

R.H. KRIEGER, U.S. Army, Ballistic Research Labs., *Aberdeen Proving Ground, Maryland* 21005 (DA0N4437)

This project covers exterior ballistics research in aerodynamics related to projectiles and missiles and the factors affecting their flight behavior and environments. Significant studies undertaken involve methods to obtain static surface pressure measurements on non-spinning secant-ogive-cylinders--to develop a method and obtain surface pressure measurements on spinning bodies of revolution using a wind tunnel telemetry technique and to develop a finite-difference computer program for computing the three-dimensional boundary layer development on spinning bodies.

These objectives are to be met through theoretical analysis and experimental testing in the BRL closed-circuit variable-density, continuous-flow supersonic wind tunnels.

SUPPORTED BY U.S. Dept. of Defense, Armament Research & Development Command, Ballistic Research Lab.

4.0026, SPECIAL STUDIES FOR THE WORLD ADMINISTRATIVE RADIO CONFERENCE

UNKNOWN, U.S. Dept. of Defense, Electromag. Comp. Anal. Center, *Annapolis, Maryland* 21402 (FA77WAI-778/1; FA160459 (TRAIS NO.))

This agreement provides for quick response applications engineering support to the Federal Aviation Administration on propagation and electromagnetic compatibility concerning spectrum negotiations in connection with the WARC. Effective utilization of the spectrum must be considered including the optimal placement of services for both current and planned usage, accommodation of long-term needs (20 years from the present), the impact of new development techniques data concerning existing and planned systems, determinations of potential EMC problem areas and necessary parameters to resolve these problems, and the establishment of improved methods of resolving existing problems.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

4.0027, COMPUTATION OF THREE-DIMENSIONAL AERODYNAMIC FLOW

K.C. WANG, Martin Marietta Corporation, *Baltimore, Maryland* 21227 (DF044900; F49620-76-C-0004)

AF function - the design of reentry vehicles. Deficiency - no efficient method exists for computing complete flow fields past 3-d bodies at angles of attack. Objective - this research intends to develop efficient numerical and computational schemes for solving 3-d Navier-Stokes equations of flows past bodies at angles of incidence. How work contributes - techniques developed may be used in conjunction with wind tunnel data for the design of reentry and aerospace vehicles.

This effort will investigate the solution of unsteady, three-dimensional, compressible, laminar Navier-Stokes equations by the use of an implicit splitting method which incorporates the unconditionally stable Crank-Nicolson schemes for the viscous flow and the basic Lax-Wendroff concept for the inviscid flow. Implementation in the form of a computer code for a Univac 1108 computer.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0028, DISTURBING FORCES TO AIRCRAFT ENCOUNTERING WAKE TURBULENCE

C.E. BROWN, Hydronautics Incorporated, *Laurel, Maryland* 20810 (DF043330; F44620-76-C-0073)

AF function - aerospace vehicles. Deficiency - present knowledge of the forces and moments produced in an aircraft encounter with wake turbulence generated by another aircraft is not sufficient for safe and efficient use of a large mix of aircraft in the operational environment characteristic of Air Force missions. Objective - to obtain a complete understanding of the dynamical interaction process involved in wake vortex encounters so that proper training and operational guidance can be given to pilots, flight controllers and mission planners to minimize or eliminate the encounter hazard. How work contributes - while much basic insight into the mechanisms for generating wake turbulence has been obtained more understanding is still needed to predict the vortex field and its induced reaction on an encountering aircraft. Simulation studies using human pilots in the loop make use of calculated aircraft forces and moments which are based on simplified assumptions for the vortex field as well as for the interaction and these computations have not been checked by full-scale or proper model test data. This effort proposes to rectify the current situation by performing critical six-component force and moment measurements on models representative of typical modern high-speed aircraft in a laboratory-controlled vortex encounter and the data obtained will be compared with current theoretical estimates that are used in flight simulation to assess the validity of these calculated input results.

The recent adaptation of ship model towing basins now permits the generation of basic vortex interaction data that can be used directly as a basis for or as a verification of theoretical models for this dynamical interaction. Using an existing large model of the Boeing 747 as the wake generator and a smaller sting mounted model, similar in geometry to current high-speed military aircraft, all six reaction components will be measured in model tests at high Reynolds numbers and properly scaled separation distances and the results will be compared with theoretical prediction models of the vortex encounter. The tests will be carried out in the hydronautics ship model basin.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0029, SPARE PARTS FOR NLM SATELLITE BIOMED COMMUNICATION SYSTEM

UNKNOWN, Microdyne Corporation, *Rockville, Maryland* 20850 (N01LM74714 (CONTRACT))

SUPPORTED BY U.S. Dept. of Health Education & Welfare, National Inst. of Health, National Library of Medicine

4.0030, APPLICATIONS OF INFORMATION AND SYSTEM THEORY TO AIR FORCE PROBLEMS IN COMMUNICATIONS AND DATA HANDLING

J.K. WOLF, Univ. of Massachusetts, Graduate School, *Amherst, Massachusetts* 01002 (DF037370; AF-AFOSR-2601-74)

AF function - to advance the theory and design of high-performance communications systems for use in Air Force command

and control functions. Deficiency - the subject of coding and decoding is still very young, and there are important cases for which there is a scarcity of practical ways to implement the needed codes. Another area where improvements can be expected is in multiple-user communications systems in which several transmitters are sending to one or more receivers. Objective - this research is aimed toward advancing the theory in three particular problem areas: (1) multiple-user channels in which there is no feedback to the transmitters, so there can be no synchronization between transmitters and receivers, (2) the application of information theory to data handling, such as the design of instruction codes in microcomputers, and (3) the construction of coding and decoding algorithms for additive Gaussian channels with or without intersymbol interference. How work contributes - the results of this research could be a significant contribution toward the design of more efficient and flexible communications equipment.

Work will continue in the area of multiple-user communication systems, where it cannot be assumed that the transmitters are synchronized with the receivers. The capacity region for this case will be determined. Another area to be investigated is the decoding of linear block codes, where cyclic codes are used and channel information is available at the receiver. A third important area that will be treated is fault-tolerant computers. The plan is to investigate how block coding, which has been used in communications, can be modified to apply to arithmetic codes.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0031, SPECTRAL REQUIREMENTS FOR DEFENSE SYSTEMS CODES

I.L. KOFSKY, Photometrics Incorporated, *Lexington, Massachusetts* 02173 (DF249720; F19628-77-C-0201)

AF function - communication, surveillance, detection, tracking. Deficiency - predictive capability for electron concentrations and other atmospheric parameters following atmospheric nuclear bursts. Objective - identification of the visible and ultraviolet spectral data requirements most needed for digital computer codes used to predict atmospheric nuclear effects. How research contributes - this study will allow our in-house program to concentrate its limited resources on the most important inputs for codes such as OPTIR, ROSCOE, HARC, etc.

Problem areas in systems codes will be identified and correlated with deficiencies in the spectral data used as inputs to the codes. The sensitivity of the effects to possible uncertainties in the inputs will be considered. Particular attention will be given to defense systems codes in the areas of satellite communications, electronic and optical surveillance, and tactical military operations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

4.0032, THE INVERSE PROBLEM OF SCATTERING

H.E. MOSES, Univ. of Lowell, Graduate School, *Lowell, Massachusetts* 01854 (DF046160; AF-AFOSR-3169-77)

AF function - radar detection of aerospace vehicles. Opportunity -existing mathematical techniques promise improvements in the design and use of radar. Objective - inverse scattering techniques which should be applicable to certain microwave filter designs. How work contributes -improved techniques for inverse scattering should produce new design and analysis techniques.

Inverse scattering theory such as the Gelfand-Levitan approach has resisted application for many years due to the lack of work in areas related to range, domain, null space and their approximate analogues relevant to measurement and modeling errors. The example of design of a microwave filter as a finite-length transmission line will be investigated. The range of reflection and transmission coefficient attainable and the sensitivity to modeling error will be attacked from both the small perturbation and the variational principle points of view. Additional work on three-dimensional problems, nonlinear wave equations solvable by inverse scattering transform, and ionospheric measurement will be considered, time permitting.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0033, CONTROLLED INVERSION DEVICES FOR HIGH-RELIABILITY SEMICONDUCTOR MEMORIES

H. KROGER, Sperry Rand Corporation, *Sudbury, Massachusetts* 01776 (DF901110; F19628-76-C-0105)

AF function - improved missile and satellite systems. Deficiency or opportunity - need for a reliable LSI random access memory. Objective - a new memory element, the controlled inversion device, has been invented by Sperry Research Center. This investigation will extend the understanding of the bistable impedance states of the controlled inversion for LSI applications. How research contributes - the potential utility of the controlled inversion device will be exploited for applications such as random access memories. The CID technology will be developed for use in high-yield, high-reliability semiconductor technology for LSI applications.

The main emphasis of the program is to develop and demonstrate all the factors which must be taken into account if an LSI version of the CID is to be accomplished, and it consists of three tasks - 1. Completion of basic theory of CID operation, 2. Study of nonlinear conductors, and 3. Array studies.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

4.0034, ADVANCED PROCESSOR USING HOLOGRAPHIC OPTICAL ELEMENTS

J.R. FIENUP, Environmental Res. Inst. Mich., *Ann Arbor, Michigan* 48107 (DF042840; F44620-76-C-0047)

AF function - future Air Force weapons systems will require the real-time processing of data obtained from a multitude of sensors at data rates which exceed current capabilities. The most promising solution at the present time is the use of the parallel processing capability of optics. Opportunity - optical processors currently require complex lenses which are heavy, bulky, and expensive. The proposed effort will investigate holographic optical elements (HOEs) which offer advantages of a reduction in the mechanical stability problems of conventional optical systems, a reduction in the number of optical elements, and a reduction in weight, size, and cost, all of which render these elements very applicable to the development of optical systems for aircraft and missiles. Objective - this research will demonstrate the feasibility of employing HOEs in optical processors. How work contributes - this effort advances optical processors for airborne and terminal guidance applications.

The optimum processor design will be selected based on the previous year's effort, and the required holographic optical elements will be fabricated and evaluated. The evaluation will be done using matched filtering employing terrain imagery. The final step will be the integrating of the HOEs and a light modulator to form the processor. Real-time coherent optical processing will then be demonstrated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0035, WIDEBAND AVIONIC MULTIPLEX SYSTEM

E.D. JENSEN, Honeywell Incorporated, *Minneapolis, Minnesota* 55413 (DF105990; F33615-76-C-1285)

Recent developments in avionic multiplexing baseline technology include remote terminals with data processing capability and wideband optical data bus hardware. However, no system architecture design has been developed to fully utilize these new technologies in advancing the state-of-the-art of avionic multiplexing. As avionic systems become more complex, Air Force requirements for multiplex system performance will become increasingly stringent. Greater system capacity and fault tolerance as well as EMI/EMP resistance will be necessary in order to allow an increasingly complex proliferation of avionics subsystems to function together as a system in a reliable manner. Consequently, the objective of this program is to develop an avionic system architecture utilizing remote terminals with microprocessing capability and designed to interface with an optical data bus with a capacity of ten mbps. Emphasis will be placed on improved multiplex system performance, increased fault tolerance and reduced cost. No hardware is to be built.

The approach is to determine what multiplex system design trade-offs were made due to bus data rate in one mbps twisted-

shielded pair systems. Develop a new architecture which will utilize a higher bus data rate and 'smart' terminals to minimize these trade-offs and improve system performance in any other areas practicable with emphasis on reliability and cost.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0036, WIND TUNNEL MODEL FOR AERO-OPTICAL INTERACTION STUDY (PHASE II)
B. WEBER, McDonnell Douglas Astro. Co., *St. Louis, Missouri* 63166 (DF187840; F29601-76-C-0088)

The objective of this effort is to obtain modification of an existing model for use in a wind tunnel investigation of interaction of an aerodynamic flow and a propagating optical (laser) beam. The effort includes design of required modification, fabrication, maintenance and support of the model. The proposed modification is focused at a closer approximation of actual in-flight configurations. The model is to be used in the NASA Ames Research Center 6 x 6 foot transonic wind tunnel.

In this effort the contractor, using his own experience in the area and detailed objectives and plan of the experimenters (the AFWL and NASA/ARC), will design the proposed modifications of the wind tunnel model suitable for performing an experimental investigation of the interaction between an aerodynamic flow over and into a cavity and an optical beam propagating from the cavity. The design will be accomplished in close coordination with the users. Upon approval of the design, the contractor will modify the model. He will then deliver the model to NASA/ARC, install it in the 6 x 6 foot wind tunnel, and provide maintenance and support during the experiments.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Weapons Lab.

4.0037, THIN SEMICONDUCTING FILMS DEPOSITED BY SPUTTERING
R.J. SOUKUP, Univ. of Nebraska, School of Engin. & Technology, *Lincoln, Nebraska* 68508 (DF046480; AF-AFOSR-3155-77)

AF function - microwave solid-state devices are essential elements of Air Force communication, reconnaissance, surveillance, and countermeasure systems. Improved performance of devices that generate and process microwave signals can be expected from use of purer solid state materials and sharper boundaries between these materials. Opportunity - present microwave solid-state device performance is limited by the inability to grow very thin high-purity low-defect uniformly doped layers with abrupt doping levels. Thin films are currently produced by several methods such as liquid-phase epitaxy (LPE), chemical vapor deposition (CVD), and sputtering, each having advantages and disadvantages. Objective - the objective of this research is to improve the sputtering technique for doped compound semiconductor thin films. How work contributes - this research will add to the body of knowledge required for the determination of the potential of the sputtering technique in comparison with other methods of producing doped semiconductor thin films.

A compound semiconductor such as GaAs will be sputtered while co-sputtering a constituent of the compound to maintain stoichiometry and/or co-sputtering an impurity dopant. The electrical and transport properties of the sputtered film will be determined.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0038, NUMERICAL SUPERSONIC FLOW FIELD STUDIES FOR NAVAL AIRCRAFT AND MISSILES
S.I. CHENG, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (DN123280; N00014-75-C-0376)

The development of accurate methods to compute the flow fields about wings and bodies for complex flow situations is essential for the aerodynamic design of aircraft and missiles. In the proposed investigation, the flow over a yawed cone and the interaction of a shock wave with a boundary layer will be studied within the framework of the Navier-Stokes equations. The cone problem is representative of the flow over the forward portion of a maneuvering missile or aircraft and the shock wave study is representative of transonic flow on an airplane wing.

Many complex flow situations about aircraft and missiles cannot be calculated with reliability by existing theory. Developments in computer technology together with advances in numerical methodologies now make the study of these complicated flows, within the framework of the fundamental equations of motion, an extremely attractive and fruitful approach. Major emphasis will initially be on the shock-boundary layer interaction problem. Both laminar and turbulent boundary layers will be treated; a phenomenological model will be used to describe the turbulent layer.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0039, WIND TUNNEL WALL INTERFERENCE
E.H. DOWELL, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (DF048590; AF-AFOSR-3337-77)

AF function - advanced aerospace vehicles. Deficiency - with the trend towards larger and/or higher performance transonic vehicles, engineering design will have to be reduced to a more rigorous science than is now possible with the present state of knowledge or simulation of transonic flow. Of prime importance for the future will be the ability of the scientist and engineer to obtain model data of unprecedented accuracy in transonic tunnels, thereby minimizing the costly consequences of errors in scaling model results to full-scale flight conditions. One of the problems in wind tunnel testing is the magnitude of the wind tunnel wall correction that must be made, particularly for large lift coefficients and/or unsteady (time-dependent) flows. Objective - the purpose of this research is to advance the state-of-the-art in analytically modeling the fluid dynamics of the flow about and through transonic wind tunnel walls and thereby provide theoretical guidance as to the magnitude of the wall interference correction as well as to improvements that can be made with designs of new wind tunnel walls. How work contributes - the vehicle designer relies heavily on data obtained in laboratory facilities to either improve or verify his design approach. Of prime importance in using this laboratory data is a firm grip on the exact magnitude of the facility interference on the data obtained. This problem is particularly acute in transonic testing where, in current facilities, significant corrections to the data are needed to account not only for facility artifacts but also scale.

A purely theoretical study wherein an attempt will be made to develop more sophisticated theoretical models of the flow about and/or through transonic wind tunnel walls. Walls to be considered will include solid flexible, slotted and porous configurations. After developing these models theoretical estimates will be made of the interference provided by these walls for two- and three-dimensional flows, both steady and unsteady. The concept of small perturbations of the infinite atmospheric solution will be used to obtain the magnitude of the wall interference.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0040, DESIGN AND FABRICATION OF HARDENED COMOS
S. TEITELBAUM, Radio Corporation of America, *Princeton, New Jersey* 08540 (DF099130; F33615-74-C-1175)

To develop a low-cost, high-speed, radiation-hardened computer fabrication technology using LSI CMOS/SOS technology.

Using CMOS/SOS technology with a radiation-hardened gate insulator (Al_2O_3) which has been demonstrated to be capable of high total dose radiation levels, fabricate the chips for a radiation-hardened CPU, and then fabricate the CPU. Do performance testing to demonstrate the radiation performance capability of the technology.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0041, WIND TUNNEL STUDIES OF AERO-OPTICAL INTERACTIONS

W.H. BAILEY, U.S. Air Force, Weapons Laboratory, *Albuquerque, New Mexico* 87117 (DF184310)

The objective of this effort is to gain an understanding of the interaction between an optical beam and an aerodynamic flow field such as exists around an aircraft. The degradation of an optical beam propagating through the atmosphere from an aircraft arises primarily from the flow field around the aircraft, up to quite long ranges. A detailed understanding of these effects is lacking. Moreover, what experimental data exists shows a lack of correlation between wind tunnel model results and measurements made in flight. This effort aims both to develop a thorough theoretical and experimental understanding of the aero-optical interaction, and to determine scaling laws between wind tunnel and in-flight results.

The approach to be taken in this effort is to first perform detailed and exhaustive studies of the aero-optical interaction using simple wind tunnel models. The aerodynamic parameter characterizing the flow around the models will be measured in detail, and correlated with the observed degradation of a laser beam propagating across the flow. The aerodynamic parameters to be investigated include the thickness of the turbulent boundary layer, the scale size of turbulence, separated and shear layer flow, oblique shock waves, and steady-state (potential flow) density gradients. Optical measurements will include modulation transfer function, point spread function, intensity scintillation, angle-of-arrival fluctuation, and induced steady-state aberrations. The experimental efforts will be conducted as a joint Air Force-NASA effort at the NASA/Ames Research Center. Concurrently, theoretical studies will be undertaken to determine the scaling of the aero-optical effects between wind tunnel models, experiments, and aircraft flight experiments. The wind tunnel measurements described above will serve as input to this theoretical study. Additional experimental input and verification will come from airborne propagation experiments undertaken by the AFWL in a separate program. Finally, scale models of aircraft turrets will be investigated in wind tunnels to both verify the theoretical analyses developed and to optimize optically the turret design. The program is primarily in-house. Contractor support will be required for design and construction of wind tunnel models.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Weapons Lab.

4.0042, AIRBORNE LASER PROPAGATION

K.G. GILBERT, U.S. Air Force, Weapons Laboratory, *Albuquerque, New Mexico* 87117 (DF169570)

To evaluate the effects of the aerodynamic environment on laser beam propagation. These effects include absorption and scattering by aerosols, boundary layer and atmospheric turbulence, flow field perturbations and shock-wave interactions.

Wind tunnel model testing will be compared with flight test and theoretical predictions of optical degradations due to boundary layer turbulence, flow field and shock effects. Optical measurements will also be made on free air atmospheric turbulence in conjunction with balloon-borne and aircraft-mounted microthermal probes, and compared with meteorological data.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Weapons Lab.

4.0043, ANALYTICAL INVESTIGATION OF MULTINOZZLE PLUME FLOW FIELDS

S. RUDMAN, Grumman Corporation, *Bethpage, New York* 11714 (DF042270; F44620-76-C-0021)

AF function - offensive and defensive sensors rely upon predicted plume observables for tracking enemy missiles. Deficiency - current prediction techniques rely upon an inaccurate equivalent single engine concept in estimating the observables from multiple-nozzle plumes. Objective - the prediction of the flow field on multiple nozzle systems by analytic study and numerical calculation to determine the effect of the impingement of the individual plumes on each other. How work contributes - allows the design of more accurate missiles and more reliable intelligence satellites.

A numerical technique is devised to compute the inviscid flow pattern associated with twin-nozzle plume flow fields. The technique involves the solution of the supersonic Euler equations by a forward marching technique. Shock waves and plume boundaries are treated as discontinuities which are free to float between the computational grid network. The subsonic portion of the flow field behind Mach discs is handled by an iterative technique.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0044, HIGH-SPEED ROTOR NOISE 12937-E

M.P. ISOM, Polytechnic Inst. of New York, School of Science & Engin., *Brooklyn, New York* 11201 (DA0R5571; DAAG29 76 G0035)

To calculate the sound field generated by subsonic and transonic rotor blades in hover and forward flight with particular emphasis on the relative importance of local geometry and shock waves. The proposed research is strongly relevant to the interests of the Ames Directorate at AMRDL in understanding the transonic aerodynamics and acoustics in helicopters.

To formulate the noise problem in a body-fixed coordinate system in such a way that the usual aerodynamic singularity does not occur in the radiation integrals and that the theoretical framework can accommodate nonlinear transonic aerodynamics in the blade tip region.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0045, THREE-DIMENSIONAL, NONLINEAR TRANSONIC FLOW THROUGH A COMPRESSOR BLADE ROW

W.J. RAE, Calspan Corporation, *Buffalo, New York* 14221 (DF038790; F44620-74-C-0059)

AF function - advanced turbomachinery. Opportunity - improve ability to predict flow through an axial flow turbojet engine. Objective - develop a numerical method for predicting the nonlinear, three-dimensional, transonic flow through an axial compressor blade row. How work contributes - development of a flow model for axial flow compressors will allow designers to more accurately consider the areas of engine stall, blade flutter and compressor performance in their designs.

A capability now exists for calculating the three-dimensional, supercritical flow through a row of blades within the approximation of nonlinear small disturbance transonic flow. The next step will be to incorporate a way of steeping the shock transitions. This will be done by the method of shock fitting first introduced by Moretti. Once the shock wave strengths and locations are determined the effects of shock wave/boundary layer interactions will be incorporated into the procedure.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0046, TRANSONIC SHOCK WAVE-BOUNDARY LAYER INTERACTIONS

R.J. VIDAL, Calspan Corporation, *Buffalo, New York* 14221 (DF043010; F44620-76-C-0057)

AF function - aerospace vehicles. Deficiency - present scaling techniques have not proven adequate in the extrapolation of transonic wind tunnel data to predict full-scale aerospace vehicle performance. Objective - to determine the importance of Reynolds number effects and, in particular, unit Reynolds number and local Mach number effects on the shock wave-boundary layer interaction at transonic speeds as an aid to providing adequate scaling techniques (modeling rules) for transonic testing. How work contributes - this research will help define the effects of Reynolds numbers and, in particular, the importance of more subtle effects inherent in the laboratory simulation of high Reynolds number flows (such as unit Reynolds number effects, heat transfer effects, local Mach number effects, axial pressure gradient effects, etc.) as an aid to developing more accurate scaling (correlation) and interpretation of laboratory data for full-

scale aerospace vehicle design analysis and performance prediction.

Using a Ludwieg tube in which an airfoil pressure distribution with an interacting shock wave is impressed on a flat plate, the interaction of the shock wave with a fully developed turbulent boundary layer is investigated at transonic speed at discrete airfoil chord Reynolds numbers characteristic of current transonic wind tunnels (about three million) to full-scale Reynolds numbers (about one hundred and fifty million). Measurements to be made include surface pressure and skin friction, pitot static surveys across the interaction zone and Schlieren observations of the flow field.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0047, TRANSIENT PLASMA PLUME CHARACTERISTICS IN PULSED ABLATIVE ARC

D.J. PALUMBO, Fairchild Industries Inc., *Farmingdale, New York* 11735 (DF048200; F49620-77-C-0078)

AF function - satellite surveillance, communications and navigation, advanced electric propulsion engines. Deficiency -insufficient understanding of low-temperature plasma generation and acceleration mechanisms and exhaust plume properties associated with arc jet ablative plasma thrusters and lack of realistic guidelines for predicting propulsion systems performance and plume interaction effects. Objective - to understand and develop accurate theoretical and mathematical models realistically describing the plasma generation and acceleration phenomena and plume characteristics associated with pulsed ablative arc plasma discharges (i.e., pulsed ablative thrusters). How work contributes - will provide additional understanding and realistic analytical modeling of the unsteady plasma generation and acceleration processes via ablative arcs and the accompanying exhaust plume characteristics and will contribute to establishing realistic design criteria for development of better pulsed ablative plasma thruster devices with desirable plume characteristics.

Theoretical and experimental studies of transient hypersonic plasma plumes in vacuum environment associated with pulsed ablative arc discharges will be carried out. Emphasis will be on determination of pulsed plasma thruster plume properties, including plume geometry, structure and chemical composition. A Monte Carlo simulation technique will be used to suitably describe the plume analytically. The physical model will treat the exit plane of the nozzle as a point source with all initial properties of the fluid known as a function of time. The three-dimensional unsteady plume flow will be computed using the Monte Carlo stochastic model. Verification of the model will be carried out via a concurrent experimental diagnostics program which will consist of Langmuir probe measurements to determine electron number density, electron temperature, and plasma velocity in three dimensions as a function of time.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0048, THEORY AND APPLICATION OF UNSTEADY FLOWS

S.F. SHEN, Cornell University, School of Engineering, *Ithaca, New York* 14850 (DF038390; AF-AFOSR-2659-74)

AF function - advanced aerospace vehicles and air-breathing propulsion systems. Opportunity - increase our understanding of unsteady flows, i.e., flows that vary significantly with time. Objective -continue study of unsteady boundary layers. Areas of emphasis will include separation and flow through turbomachinery. How work contributes - will provide analytical methods capable of solving specific unsteady flow problems.

An analytical approach to time-dependent flows will be pursued. Computations for a class of semi-similar problems will be done in order to develop an approximate method which can be used as a tool for handling certain classes of unsteady flow problems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0049, FINITE-ELEMENT TECHNIQUES FOR AERODYNAMIC COMPUTATIONS OF COMPLEX CONFIGURATIONS

S.F. SHEN, Cornell University, School of Aero. & Mech. Engin., *Ithaca, New York* 14850 (DN223121; N00014-75-C-0375)

The development of accurate and rapid methods for the prediction of the flows about complex configurations is essential for the design and optimization of naval aircraft and missiles. This task will provide for a systematic study of finite-element methods as applied to such flows.

The computation of the flows about complex configurations in aeronautics now tax, and will continue to tax for the foreseeable future, the capabilities of the most advanced computing machines. Hence there is a continuing need to explore and develop new and more efficient methodologies for complicated flows. The major numerical method to date has centered about finite-difference approximations to the governing partial differential equations. Alternate procedures are being developed based on finite-element approximations--approximations which appear to be more practical for complex geometries. These finite-element methods may or may not employ variational principles. This research will systematically examine various aspects of the finite-element method. Initially, inviscid incompressible flow will be studied, utilizing a variational principle, with emphasis on the body geometry. These results will be assessed against exact solutions. The major emphasis will be devoted to a study of inviscid compressible aerodynamic problems including transonic flows.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0050, THE INFLUENCE OF COMPLIANT SURFACES ON THE STRUCTURE OF TURBULENT FLOWS

M. LESSEN, Univ. of Rochester, School of Engin. & Appl. Sci., *Rochester, New York* 14627 (DN575369; N00014-75-C-0870)

Viable techniques for reducing the turbulent skin friction of wings and bodies at all speeds have been a perennial goal of fluid dynamic research since the evolution of such techniques would lead to, for example, improvement in the performance of aircraft, missiles and ships. The proposed research will be a theoretical study of the coupling of the shear waves in a compliant surface with a turbulent boundary layer and the effects of the interaction on the Reynolds stresses, stresses which are directly related to the skin friction.

Recent careful experimental measurements in air have indicated significant reductions in turbulent skin friction when the test surface was made compliant. Though there are evolving empirical correlations of the data which are useful for planning future research programs and for examining possible applications, little fundamental information exists to explain the phenomenon. The proposed research will examine a possible mechanism for explaining the drag reduction and, hopefully, lead to a better insight into material selection for maximizing the gains.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

4.0051, SOUND TRANSMISSION THROUGH SUPERSONIC JETS

I. GREBER, Case Western Reserve Univ., School of Engineering, *Cleveland, Ohio* 44106 (DF040030; AF-AFOSR-2750-75)

AF function - improved aerospace vehicles. Opportunity - reduce noise level from supersonic jet. Objective - to study the transmission of sound from a supersonic jet to the surroundings. How work contributes - a better understanding of the phenomena and mechanism of sound transmission will allow aircraft to be designed which are quieter without a performance penalty.

The main emphasis of this study will be to experimentally determine the spatial distribution of sound pressure at the frequency of the sound source and its alteration at other frequencies without the synthetic source present. A theoretical description of the phenomena will be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0052, RECONNAISSANCE AND SURVEILLANCE DYNAMIC ANALYZER COMPLEX
R.E. FREEMAN, U.S. Air Force, Avionics Laboratory, *Dayton, Ohio* 45433 (DF093540)

To operate, maintain, update and instrument the dynamic analyzer complex for performing routine and unique tests on advanced reconnaissance sensors and other types of avionics hardware. Develop new and modify existing facilities of the dynamic analyzer complex.

This effort shall include all aspects of laboratory performance evaluation requirements with prime responsibility for test and facility set-up, operation, maintenance, instrumentation and engineering design and film processing.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

4.0053, AERODYNAMIC CONFIGURATION DEVELOPMENT
J.L. TERRY, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF131400)

Advanced systems for air defense, tactical and strategic purposes require vehicles that operate at increased speeds and operational efficiency. The next generation of aerospace vehicles face technological deficiencies in such areas as aerodynamics, propulsion and materials. Because of increased complexity, early identification and resolution of significant problems are required to reduce acquisition costs and development time. The objective of this effort is to define aerodynamic configurations incorporating advanced technologies to establish a firm data base for the purpose of transitioning technology into future military aerospace vehicles.

The technical areas of aerodynamics, heating, propulsion, materials, stability and control and cockpit visibility will be evaluated during generation of conceptual configurations. The feasibility of applying new technologies will be assessed continually. The aerodynamic and performance characteristics of these configurations will initially be estimated using trade studies involving theoretical prediction techniques. Those found to be acceptable will be incorporated into a predesign analysis and tested in ground facilities to experimentally verify the aerodynamic characteristics. A prime consideration for all facets of this effort will be fuel economy in application to new designs as well as existing systems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

4.0054, TURBOMACHINERY FLUID MECHANICS
A. WENNERSTROM, U.S. Air Force, Aeropropulsion Laboratory, *Dayton, Ohio* 45433 (DF458780)

The objective of this task is to contribute to the aerodynamic technology required to design turbomachinery of low aspect ratio and high stage loading. This is fundamental to reducing the manufacturing and maintenance costs and improving the mechanical integrity of aircraft turbine engines.

The approach involves three parallel lines of effort: (a) analytical methods are being upgraded to include three-dimensional and time-unsteady effects, (b) data are being obtained through controlled experiments and advanced instrumentation, better defining three-dimensional and time-unsteady features of the turbomachinery gas path, and (c) design innovations such as splitter vanes, vortex generators for boundary-layer control, etc., are being experimentally evaluated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

4.0055, ULTRASONIC PROCEDURES FOR THE DETERMINATION OF BOND STRENGTH
J.L. ROSE, Drexel University, School of Engineering, *Philadelphia, Pennsylvania* 19104 (DF036210; AF-AFOSR-2480-73)

AF function - in order to improve Air Force goals for cost-effectiveness management, new and more reliable NDE techniques are needed. Opportunity - adhesive bonding techniques are always being developed for design and materialogical improvements in airframe structures and system components. This research program represents an opportunity to contribute to what is known about the use of advanced ultrasonics as an NDE tool with potential for application to adhesively bonded structures. Objective - the objective of this research is to experimentally develop a better understanding of ultrasonic NDE methods for different materials used in structural bonding. How work contributes - this research contributes to the overall research program seeking to improve the Air Force's inspection accuracy and credibility reliability.

This research continues to utilize ultrasonic inspection techniques to characterize bonding defects. Computerized signal processing will continue to be utilized for development of an advanced inspection system that will eventually increase both reliability and speed of Air Force inspection procedures. The areas of concentration for this FY77 task will include both inspection speed and deterministic logic.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0056, AN ANALYTICAL STUDY OF POWERED MISSILE AERODYNAMIC PERFORMANCE 14966-A-E
J.M. WU, Univ. of Tennessee, School of Engineering, *Knoxville, Tennessee* 37916 (DA0F8972; DAAG29 77 G0108)

To develop calculation techniques as well as a basic phenomenological understanding that allow the aerodynamic characteristics of realistic missile configurations to be estimated and optimized. Relevance - the understanding and prediction of the aerodynamics of canard-body-fin configurations at angle of attack is of greatest relevancy to the design and development of high-performance tactical missiles and therefore has great impact to the Army's need for greater firepower.

Utilizing existing potential flow analyses, viscous flow past missiles at angles of attack will be determined including the effects of fins, fin tips and wake interactions. The resulting model will be utilized to examine aerodynamics of canard-fin-elevon combinations including effects of blunt noses and small geometric imperfections.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

4.0057, TURBULENT MIXING RESEARCH
P.T. HARSHA, Arnold Research Org. Inc., *Tullahoma, Tennessee* 37389 (DF420818; F40600-75-C-0001)

The objective of this experimental and analytical project is to develop reliable prediction techniques for high-speed turbulent mixing processes, including those flows with exothermic chemical reactions.

Special emphasis is placed on mixing systems which are used in propulsion devices and ground testing facilities.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Arnold Engineering Development Center

4.0058, MASS SPECTROMETER FLOW FIELD STUDY
T.D. MCCAY, Arnold Research Org. Inc., *Tullahoma, Tennessee* 37389 (DF421017; F40600-75-C-0001)

Measure the density and rotational temperature profiles about the skimmers of two scale models of the AFGL mass spectrometer probe immersed in a Mach 3 flow of N2 at several angles of attack and altitude and analyze the data.

A test program will be planned and data will be obtained, analyzed and reported.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Arnold Engineering Development Center

4.0059, AUTOMATIC RECOGNITION AND TRACKING OF OBJECTS
J.K. AGGARWAL, Univ. of Texas, School of Engineering, *Austin, Texas* 78712 (DF046640; AF-AFOSR-3190-77)

AF function - the development of Air Force weapon systems is becoming increasingly dependent on the real-time automatic

detection, identification, and tracking of targets. Opportunity - at present, the ability of machines to perceive their environment is very limited. Current pattern recognition systems are capable of only identifying objects with simple contours or identifying a very limited set of target signatures. How work contributes - this effort will advance the Air Force capability in detecting, identifying, and tracking targets. Objective - the overall objective of this research is to develop computational and experimental tools for the analysis of aerial color photographs of a complex scene containing objects which are small, moving, and possibly occluding one another.

The research program includes the extension of the existing scene-analysis algorithms to the recognition of curved objects in a scene, the study of the role of motion in order to enable the application of the recognition system to real situations such as detecting and tracking of objects, and the use of color information for extracting meaningful objects from the background of the given scene as well as for detecting and tracking the objects from the aerial color imagery.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0060, HIGH-INTENSITY SOUND

D.T. BLACKSTOCK, Univ. of Texas, School of Engineering, *Austin, Texas* 78712 (DF042700; F44620-76-C-0040)

AF function - advanced aerospace vehicles. Deficiency - lack of basic understanding of sound waves of very high intensity. Objective -achieve a fundamental understanding of the behavior of finite-amplitude (i.e., very intense) acoustic waves and apply this understanding to important problems of defense technology. How contributes - major sources of the sound waves under investigation are jet and rocket engines. Understanding of this phenomenon will enable the Air Force to remove or at least lower the noise level found around aircraft and air fields.

Research in high-intensity sound will be carried out in three areas: (1) finite-amplitude noise, (2) modulation of sound by sound, and (3) diffraction, reflection, and focussing of n waves. This will be a combined theoretical and experimental program.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

4.0061, EXPLOSIVE-DRIVEN MAGNETOHYDRODYNAMIC GENERATOR FOR SHORT-PULSE HIGHPOWER AIRCRAFT

C. BANGERTER, Hercules Incorporated, *Magna, Utah* 84044 (DF453800; F33615-72-C-1394)

Investigate detonation-driven (explosive) magnetohydrodynamic generator with emphasis on high repetition rate systems. Develop a technical base to allow design and construction of lightweight multimegawatt deflagrating solid fuel MHD generators.

A prototype explosive MHD generator will be designed and constructed which will produce approximately 25 kilojoules of energy in 50-100 microseconds pulses. Hercules will also construct and test a 4 mw, 4 sec burst prototype deflagrating MHD generator using solid fuel as a technology base for the design of lightweight multimegawatt devices.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aeropropulsion Lab.

4.0062, A RADIO NOISE STUDY

UNKNOWN, U.S. Navy, Off. of Naval Research, *Arlington, Virginia* 22217 (FA77WAI-774; FA160304 (TRAIS NO.))

A study shall be conducted to determine methods of eliminating VHF/UHF radio noise resulting from the proximity of antennas to lightning rods at Air Traffic Control Tower (ATCT) locations.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

4.0063, LANDSAT EVALUATION FOR AUTOMATED TERRAIN DATA EXTRACTION

T.C. VOGEL, U.S. Army, Geographic Info. Systems Div., *Fort Belvoir, Virginia* 22060 (DA0M8067)

To evaluate the image record characteristics of remote sensor systems such as LANDSAT, infrared, and radars to determine the image parameters and data content which can contribute to automated extraction of information required for topographic maps and MGI.

Through exploitation of the technical literature and other available data concerning systems imaging characteristics and applications, LANDSAT radar and infrared systems will be analyzed for image record content and how it may contribute to automated terrain data extraction. Image processing and interpretation techniques will be identified along with computer processing software or algorithms. This work will utilize representative imagery collected under the work titled: Imagery Reference Set for Automated Terrain Data Extraction.

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Corps of Engineers

4.0064, IMPROVED SMALL DISTURBANCE SOLUTIONS FOR TRANSONIC UNSTEADY FLOW

E. MURMAN, Flow Industires Incorporated, *Kent, Washington* 98031 (DF136810; F33615-76-C-3067)

High-speed military aircraft require extensive wind tunnel testing to establish flutter flight-safety. Wind tunnel testing has been necessary because transonic unsteady aerodynamic methods have not been available for flutter analysis. The purpose of this program is to (a) remove the current limitations on transonic unsteady flow computations for high-frequency oscillations at Mach numbers very close to 1.0, (b) establish a consistent treatment of unsteady shock motions within a small disturbance theory, and (c) determine if finite-element methods can be legitimately used for mixed elliptic-hyperbolic transonic flow problems. The result will consist primarily of recommendations and guidelines for future 6.2 developments of transonic flutter prediction methods.

The contractor will formulate the nonlinear small disturbance equations for transonic unsteady flow. He will examine and attempt to improve the conventional far-field boundary conditions and other factors which might tend to produce computational instabilities for high-frequency oscillatory motions at flow Mach numbers very close to 1.0. He will examine the fundamental mathematical background of the finite-element method and determine its applicability to mixed elliptic-hyperbolic transonic flow problems. He will also ensure that the theoretical method consistently treats unsteady shock motions by applying the necessary jump conditions to the order of accuracy required by consistent assumptions within the theory.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, RELATIVE DURATION OF SPORADIC E VERSUS DISCRETE AURORAL EVENTS AND DYNAMICS

S. AKASOFU, Univ. of Alaska, Geophysical Institute, *Fairbanks, Alaska* 99701 (DF261660; F19628-76-C-0074)

AF function - transpolar communications, radar and navigation. Deficiency - the polar ionosphere is presently very unpredictable to such a degree that the above functions are frequently degraded or crippled. Objective - investigate the phenomenology of the arctic ionosphere. How research contributes - provides inputs to in-house effort for modeling effects of particle precipitation on arctic ionosphere. This contractual effort is for the investigation of the phenomenology of arctic particle precipitation through the collection of data, and analysis of data so as to provide a framework for the interpretation of data collected by AFCRL Airborne Ionospheric Observatory, NKC-135 aircraft, number 53131, and the AFCRL Goose Bay Ionospheric Observa-

tory. The contract also provides for the interpretation of data in terms of magnetospheric phenomenology or theory.

Process and maintain aircraft and ground station all-sky camera data. Gather and interpret ionospheric and magnetospheric data for selected periods in support of special studies. Investigate ionospheric response during a magnetospheric substorm. Clarify relationship between discrete aurora and continuous aurora using DMSP data. Study auroral arc brightenings and interplanetary magnetic field changes as a predictor of substorm onset.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0002, COMPUTER MODELING OF MOLECULAR SPECTRA FOR AURORAL STUDIES

V. DEGEN, Univ. of Alaska, Geophysical Institute, *Fairbanks, Alaska* 99701 (ATM76-80281)

This grant funds a program of auroral studies in which molecular spectra are modeled on a computer for comparisons with observed data. The analytical basis is a set of computer programs for the major N2 and N2 plus molecules. The experimental data are provided by the new Geophysical Institute optical facility located at Poker Flat, Alaska. The system features two fast spectrometers and a photometer, and computer-controlled data handling and display.

The purpose is to examine and quantify excitation processes and source conditions in various types of electron and proton auroras and to provide synthetic spectra for general reference. The proposed work will involve publication of data on hand, update of existing computer decks and coding of new band systems, conversion from IBM 360/40 to a new time-sharing system under Honeywell, and further auroral observations.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0003, INTERPLANETARY FIELD STUDY

K.A. ANDERSON, Univ. of California, Space Sciences Laboratory, *Berkeley, California* 94704 (DF247230; F19628-76-C-0125)

AF function - communications and detection. Deficiency - understanding ionospheric effects caused by various auroral phenomena which cause communications degradation in the arctic. Objective -investigate the effects of the interplanetary magnetic field with various auroral phenomena and their problems. How research contributes -provides inputs to in-house work efforts in substorm prediction and ionospheric mapping. This contractual effort is for investigation of the IMF and its relationship to various auroral phenomena and the predictive indications inherent in the IMF behavior. Interpretation of IMF parameters in terms of auroral phenomenology provide a background for the interpretation of data collected by the AFCRL Airborne Ionospheric Observatory, NKC-135 S/N 53131.

Assemble and interpret IMF data to specify a given ionospheric state and structures associated with the chosen state. To correlate the specific states and structures with DMSP photos and aircraft data. To identify any precursor states or structures which warn of impending substorms or other magnetic disturbances.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0004, MEASURE KILOMETERS USING CRYOGENIC SAMPLING

UNKNOWN, Natl. Center for Atmosph. Res., *Boulder, Colorado* 80302 (FATQWAI-684; FA59700 (TRAIS NO.))

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

5.0005, RELATION OF INFRARED DOPPLER LIDAR TO REMOTE WIND MEASUREMENTS IN THE TURBULENT ATMOSPHERE 13470-GS

R.L. SCHWIESOW, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., *Boulder, Colorado* 80302 (DA0Z5575)

Develop basic information on the effects of the atmosphere on coherent (homodyne) infrared Doppler lidar, and from the atmospheric limitations predict system potential for remote wind measurement. The Army needs a capability for real time, high resolution spatial and temporal wind measurements to be used in the correction of artillery fire, to increase safety and efficiency of aircraft landing and take-off from remote airfields, and to predict transport and diffusion of gasses and particulates (pollutants) in the atmosphere. The research also has application to detection of chemical agents in the atmosphere.

Experiments will be conducted in the atmosphere using an existing infrared Doppler prototype instrument at an optical test range at NOAA Table Mountain field site. The signal level and effective telescope diameter for coherent optical processing will be determined for various meteorological conditions. Based on these results, an analysis will be made of the feasibility of a remote differential Doppler configuration for measurement of velocity components perpendicular to the bisector of the intersecting incident beam.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

5.0006, ENVIRONMENTAL REMOTE SENSING

V. NOBLE, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN220038)

Operational commanders can improve mission effectiveness by exploitation of environmental intelligence only when the environmental parameters are quantified and provided in a timely, deterministic manner in a useable format. The objective of this effort is to develop sensors, analysis methods, and display techniques for improved command support.

Theoretical studies and field measurements are carried out to establish analysis techniques for determination of oceanographic parameters from interaction of electromagnetic waves with the sea surface. Sensors will be developed, and their performance evaluated to confirm that their measured outputs do quantify the sea surface parameter to the accuracy and precision necessary for Navy needs.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

5.0007, DELTA-K RADAR DEVELOPMENT PROGRAM

D.L. SCHULER, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN480224)

The purpose of this research project is to determine the effectiveness of a coherent dual-frequency correlation radar for achieving (a) improved target detection, and (b) remote sensing of ocean waves and surface currents.

The delta-k radar transmits two closely-spaced RF frequencies and, upon reception, cross-correlates the coherently detected backscattered EM fields to achieve improved detection and classification for both fixed and moving ship targets. Improved detection is possible because, although the radar is highly directional, the output has the characteristics of hf return from ships and the sea. Target glint and scintillation effects are reduced and coherent integration of returns is possible over long periods.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

5.0008, REMOTE SEA STATE AND WEATHER DETECTION BY HF RADAR

D.B. TRIZNA, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN480014)

To investigate experimentally and theoretically the scattering mechanisms responsible for the radar sea backscatter spectrum at HF, for use in long-range radar sensing of sea conditions. Present methods depend on ship reports and inferences from weather maps. They tend to leave sizeable ocean areas without adequate ocean wave data. Certain naval operations depend on this type of information. All ship routing activities are obvious users of this data; however, both surface and subsurface naval operations can be restricted or even prohibited by high sea-state conditions. Thus

good real time ocean wave knowledge is essential for the intelligent applications of naval force.

Use NRL HF radar at Chesapeake Bay Division and sea echo site on San Clemente Island to gather radar backscatter spectra from the North Atlantic and North Pacific Oceans, respectively, for analysis, interpretation and comparison with ground truth data. These include NWS weather charts for large-area mapping, and ocean weather ships, NOAA buoys, and aircraft overflights using laser profilometers and Stillwell photographic techniques for details of localized conditions. Continue development of the scattering model describing higher order features in the radar spectrum.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

5.0009, HF RADAR SPECTRAL ANALYSIS FOR REMOTE SEA SENSING

D.B. TRIZNA, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN580094)

The aim is to develop techniques for the extraction of oceanographic and meteorological parameters from Doppler power spectra of HF radar energy backscattered from the sea. These techniques will be applied toward remote sensing operations of an over-the-horizon HF radar collecting data from cells contained in ocean areas over millions of square miles. Naval ship routing activities are regular users of such data, which is presently reported by ships at sea, a technique which tends to leave large areas unreported on. Both surface and subsurface naval operations can be severely restricted by lack of data from such areas. Thus, comprehensive real-time knowledge of ocean waves is essential for the intelligent application of naval forces.

Use sea echo radar on San Clemente Island to collect and analyze high azimuthal resolution data (2 deg) in the surface wave mode to investigate Doppler spectrum of statistical variations with azimuth and radar frequency. These are useful for knowledge of the statistics of the sea surface as a function of sea state, as well as for comparison with ionospheric target fading statistics.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Research Lab.

5.0010, SEMI-AUTOMATIC EXTRACTION FROM AERIAL PHOTOGRAPHS

H. KAZMIERCZAK, Res. Soc. for Appl. Nat. Sci., *Karlsruhe, Baden Wuerttemberg, Federal Republic of Germany* 7500 (DA0D9320; DAERO 77 G0044)

To devise methodology for extraction of road patterns from aerial photographs.

The extracted objects will be represented by contour lines. This representation may then be replaced by abstract symbols. The original image is being contrast enhanced. Contour lines of the roads are approximated semiautomatically by providing points on the contour. Any step of the approximation process is controlled and may be repeated manually, in case of unsatisfying results. It is expected that the methods used can later be extended to extract other line objects as, e.g., river basins or railway lines. They can then serve to semiautomatically produce maps (scale 1 to 50,000) from aerial photograhs taken at an altitude from 10 to 20 km.

ADDENDA: Supporting agency address is: DARCOM Army R&S GP (Eur) Box 65, NY 09510. Performing organization: Forschungsgesellschaft fur Angewandte Naturwissenschaften E.V.

SUPPORTED BY U.S. Dept. of Defense, Army

5.0011, ROCKET CHARGING STUDY

H.A. COHEN, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249280)

AF function - communication satellites in geosynchronous orbit. Deficiency - electrical charging of satellites by ambient particles causing anomalous switching of electronic circuitry. Objective -development, testing and use of charge ejection systems to duplicate, prevent, or control satellite charging. How research contributes - by the development, testing and use on space vehicles of charge ejection systems, charging of satellite surfaces can be controlled for predetermined periods, obtaining either large or small potential differences with respect to ambient plasma.

A sounding rocket payload is being prepared for flight. This payload will have the dual purpose of obtaining a relationship between the charge ejected from a space vehicle, ambient parameters, and the resultant charge on the vehicle surface, and the testing of the satellite positive ion beam system to be used on the Scatha satellite.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0012, PARTICLE EFFECTS ON SPACE SYSTEM SURVIVABILITY

R.C. FILE, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF248920)

AF function - reliability, cost-effectiveness, lifetime and survivability of operations space systems. Deficiency - knowledge of the energetic particle environment necessary to adequately predict the reliability and lifetime of space systems. Objective - to determine the transient and steady-state energetic particle environment and to indicate possible effects on spacecraft performance and lifetimes. How research contributes - an extended data base from AF satellites will be used to construct realistic static and dynamic models of the near-earth particle environment.

The energetic particle environment in the near-earth space causes radiation damage to system components and hence shortens their lifetimes. This work unit will utilize an extensive data base obtained from several satellites to define the relevant energetic particle environment. Transient effects occurring during magnetic substorms can cause temporary system malfunctions. Electron data from the DMSP satellite will be used to examine acceleration events further up the field line and to correlate these events with system anomalies.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0013, VOR/OMEGA BALLOON TRACKING SYSTEMS

H. LAPING, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF243940)

AF function - advanced balloon systems (surveillance, delivery operations, environmental research support, space equipment test). Deficiency - an economical, accurate global balloon tracking capability does not exist. Objective - develop a VOR balloon tracking capability for the continental United States and an omega balloon tracking capability suitable for world-wide use. How research contributes -positive free balloon tracking, on a world-wide basis, will be possible. The accuracy and timeliness of the position information will be such as not only to satisfy both civil and military air safety requirements, but also to provide a reliable economical method to track free balloon flights over remote or inaccessible areas.

Final test flights will be conducted to confirm accuracies attainable using the VOR free balloon tracking equipment. Two test flights of a prototype omega signal processor will be conducted over the continental United States. Data from these flights will be studied to evaluate operational problems, signal quality and comparative position accuracy with respect to VOR and radar.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0014, SATELLITE ACCELEROMETER DENSITY MEASUREMENTS

F.A. MARCOS, U.S. Air Force, Geophysics Laboratory, *Bedford Massachusetts* 01730 (DF249450)

AF function - airborne surveillance, target acquisition. Deficiency - atmospheric density variations with time and space can not be accurately predicted. Objective - direct density measurements with satellite-borne accelerometers. Low satellite altitude measurements are emphasized. Results are correlated with solar geophysical parameters and other experiments. How researc

contributes - in-flight accelerometer drag measurements permit accurate determination of Air Force satellite ephemerides. Development of more accurate models allows more accurate prediction of satellite motion improving orbit vehicle surveillance capability.

Three flights of the new Seta accelerometer are scheduled during CY77 on AF/DMA satellites. Seta is a new instrument utilizing a single proof mass measure accelerations along three orthogonal axes. The instrument will be used to measure density, winds and spacecraft attitude. Acquisition and reduction of data from the AE-C, AE-E and S3-2 accelerometers will continue along with reduction of data from the decayed AE-D and S3-1 satellites. Density results from these and other accelerometer flights will be incorporated into a unified data base along with correlative data. This will permit comprehensive analyses and development of models emphasizing dynamic aspects of the lower thermosphere. A single-axis accelerometer mounted on a rotatable table will be flown on the S77-2 spacecraft. This instrument provides the capability of removing inherent bias errors which cannot be separated from drag effects in a circular orbit.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0015, ATMOSPHERIC TRANSMITTANCE AND BACKGROUNDS

R.A. MCCLATCHEY, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF257260)

AF function - target signature and background determination, airborne surveillance, remote sensing of meteorological variables, weather forecasting and modification. Deficiency - optical and infrared absorption, emission and scattering due to atmospheric gases and aerosols interfere with detection systems. We are currently not able to model the radiative properties of hot aircraft or rocket exhaust plumes. Atmospheric absorption and emission parameters are required for use in the design of satellite remote sensing equipment and in computerized weather forecasting techniques. Research - compile data relevant to absorption, emission and scattering by atmospheric gases and aerosols. Determine the extent to which spectral data are required in order to examine the problem of hot plume emission, and then develop the required data. Develop new methods to use all of these data in the prediction of atmospheric absorption, emission, and scattering. Apply these techniques to various Air Force problems, especially plume signatures and atmospheric backgrounds, laser propagation, satellite remote sensing of meteorological variables, detection of atmospheric composition. How research contributes - permits optical or infrared sensors to be designed so that they can detect targets against an atmospheric background. Contributes to selection of laser systems for best atmospheric propagation characteristics. Contributes to the optimization of frequencies used in remote meteorological sensing of the atmosphere. Contributes to the detection of aircraft exhaust products in the stratosphere. Contributes radiation models for direct use in numerical weather forecasting.

Compile complete set of spectroscopic data on magnetic tape for all atmospheric gases which have absorption features between 2500A and the far infrared. Develop computer codes capable of utilizing these data in predicting atmospheric transmittance, emission and scattering encountered in the real atmosphere. Obtain laboratory and field measurements of absorption and emission for comparison and validation of predictions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0016, CHEMISTRY OF THE UPPER ATMOSPHERE

W. SWIDER, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF244340)

AF function - communications and satellite surveillance. Deficiency - inadequate knowledge of the atmosphere, particularly during natural or man-made disturbances. Objective - study and analysis of ionospheric-atmospheric data plus laboratory measurements of certain processes. How research contributes - studies and measurements help correct deficiencies in theories and models, which lead to an improved ability to forecast visible and IR backgrounds plus radio absorption and propagation effects during atmospheric disturbances.

Experimental atmospheric data is compared with theoretical models. New interpretations are formulated to explain properly results where necessary and possible. Laboratory measurements are made of reactions thought to be of special importance during and after disturbances in the atmosphere and their effects on systems considered.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0017, AERONOMY OF DISTURBED TWILIGHT D REGION

W. SWIDER, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF249140)

AF function - communications. Deficiency - inadequate knowledge of the electron distribution and mean ionic mass of the d-region, particularly at twilight, for quiet and disturbed conditions. Objective - to provide more precise information on the distribution of electrons and ions in the d-region as a function of time and latitude under various levels of ionization. How research contributes - improved models of the d-region are developed which can be included in communications codes for computing transmission paths and phase changes at VLF and LF.

Time-dependent calculations of the d-region using the Keneshea code are compared to various experimental data. Adjustments to the code are made as regards latitude and level of ionization. Where there is substantive disagreement between the code and the data, attempts are made to remove the disagreement by making estimates of various chemical rate constants within reasonable theoretical limits. Particular emphasis is placed on rapid changes occurring in the d-region at twilight. When estimates for various key chemical rate coefficients are deemed inadequate or impossible to make with sufficient accuracy, recommendations of certain specified reactions in the laboratory are advocated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0018, CHEMICAL TRANSPORT MODELS

S.P. ZIMMERMAN, U.S. Air Force, Geophysics Laboratory, *Bedford, Massachusetts* 01730 (DF244870)

AF function - environmental impact of high-altitude flight vehicle effluents. Deficiency or opportunity - chemical-transport models for determining species and thermal distributions of the normal and affected stratosphere. Objective - theoretically calculate and describe how the normal species and thermal distributions of the stratosphere are affected by flights of Air Force aircraft. How research contributes -uses new improved time-dependent theoretical dynamical models to determine effects of operational systems such as the B-1 on the environment.

One-dimensional time-dependent dynamical model will be calculated for 60 degrees N, 38 degrees N and 5 degrees S to include coupled equations of motion and continuity for major and minor neutral species as well as experimentally determined transport coefficients for these latitudes. A one-dimensional mid-latitude calculation will incorporate nitric oxide emission equivalent to those of a supersonic transport or B-1 system to test the impact on the ozone distribution and UV absorption.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0019, MAGNETIC ACTIVITY DATA COLLECTION AND EVALUATION

J.F. DEVANE, Boston College, School of Arts & Sciences, *Chestnut Hill, Massachusetts* 02167 (DF247880; F19628-76-C-0291)

AF function - operation of systems for communications, command, control, guidance, navigation and detection. Deficiency - magnetic substorms cause degradation and false signals. Performance becomes unpredictable and maximum usable frequency drops rapidly. Objective -improvement and expansion of the data collection network for use in the specification and prediction of magnetic activity. How research contributes - any system such as AFSATCOM, or any other with a mission in the c-cubed area could be optimized if the system was provided with an accurate

specification and/or prediction of magnetic activity. Norad could anticipate critical periods for their systems and exercise options for alternatives. SAC missions aborted due to communications problems could be minimized by selection of quiet periods or be com-plan modifications.

Portions of the existing five-station data collection network will be modified and upgraded to insure maximum reliability. Instrumentation will be recalibrated as required to maintain baseline values and minimize drift. Sites for the southern network will be surveyed, shelters constructed and instruments installed and tested. System performance will be reviewed and evaluated and design changes made as required.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0020, GRADIOMETRY DISTURBANCE STUDY

S. JORDAN, Analytic Sciences Corporation, *Reading, Massachusetts* 01867 (DF246040; F19628-76-C-0286)

AF function - form optimal estimates of the disturbance potential and gravity disturbance vector for inertial guidance systems. Deficiency - insufficient gravity sensor trade-off data. Objective -develop multisensor integration method for combining various sources of geodetic data. How research contributes - develops and implements sophisticated mathematical and statistical theories.

Through the use of the integration method and computer tools developed under the previous contract, contractor will initiate preliminary sensor trade-off studies for an airborne gravity gradiometry system which also takes advantage of surface gravimetry as well as satellite data.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0021, METEOROLOGICAL STUDIES

L. BURKE, Regis College, Undergraduate School, *Weston, Massachusetts* 02193 (DF248460; F19628-77-C-0010)

AF function - weather analysis, forecasting and observing for military operations. Deficiency - inadequate weather forecasts and observations. Research - applies advanced techniques to development of improved weather analysis forecasting and observing techniques. How research and development contribute - provide improved weather analysis forecasting and observing techniques in the following areas -mathematical models of atmospheric processes (T2320G2), DMSP satellite imagery and use of AFGL man computer interactive data access system (MCIDAS) to improve satellite imagery (T669802), application of objective computer methods to aviation terminal weather (T862811), and assess environmental impact of man-made perturbations of the stratosphere (T668709).

Computerized objective methods will be used in the development of methods to combine, analyze and display estimates of cloud properties derived from satellite data (627A).

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0022, LANDSAT DIGITAL DATA CLASSIFICATION

UNKNOWN, Bendix Corporation, *Ann Arbor, Michigan*

The study will obtain and process LANDSAT digital data by computer to produce vegetation and land-use surface feature classifications according to a classification system to be supplied by FWS on the five Regional Environmental Test Sites. Error analysis and quantitative evaluation will be conducted on classification accuracy, geographic accuracy, and areal measurement precision on all areas classified.

ADDENDA: Project Officer: Denny Parker.

SUPPORTED BY U.S. Dept. of the Interior, Fish & Wildlife Service, Office of Biological Services

5.0023, THEORETICAL STUDY OF PLASMA EXCHANGE BETWEEN F-REGION AND MAGNETOSPHERE

D.G. TORR, Univ. of Michigan, Graduate School, *Ann Arbor, Michigan* 48104 (DF248710; F19628-77-C-0007)

AF function - ionosphere and magnetosphere modelling and prediction, communication, surveillance, navigation. Deficiency - inadequate knowledge of interaction between different ionospheric constituents and of equations governing their transport at all altitudes. Objective - to model the motion of different ionospheric ion species along and across magnetic field lines at low and mid-latitudes. How research contributes - the new code will give a means of predicting changes in relative abundance, density and motion of ionospheric and magnetospheric constituents at mid-latitudes. This will improve understanding of and prediction of plasma depletion and irregularities in the ionosphere which degrade performance of AF communication and surveillance systems whose ray paths traverse mid-latitude ionospheres.

A computer code will be constructed to model the motion of ionospheric ions using newly developed computational techniques which allow independent treatment of different ion species over a range of solar-geophysical conditions.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0024, ACOUSTIC EMISSIONS FROM TORNADIC STORMS

R.T. ARNOLD, Univ. of Mississippi, School of Liberal Arts, *University, Mississippi* 38677 (ATM76-08798 A01)

The primary objective of this research is to obtain high-fidelity recordings of the sound produced by tornadic storms. It is a legitimate matter of scientific debate whether or not a study of low-frequency sonic pressure waves generated in a tornadic storm can be used to gain insight into the nature of the physical characteristics of either the tornado cyclone or the larger parent storm cell. However, based on a study of three records made with low-quality acoustic recorders, the principal investigators are of the opinion that high-quality recordings can provide information about wind speeds, wind turbulence, electrical activity and the total energy associated with the wind system. The detailed objectives are: (1) The measurement of wind noises associated with wind-ground surface interactions, (2) To record thunder spectra of several travelling storm cells which cross the National Severe Storms Laboratory's (NSSL) weather network, and (3) To attempt to record the sound generated by one or more tornadoes by working closely with the Tornado Intercept Group at NSSL. Instruments suitable for recording infrasonic and sonic signals in the range from 5Hz to 10KHz will be used and the power spectra produced and analyzed. A possible practical benefit of this research is a sonic tornado early-warning detector.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

5.0025, PROJECT DA VINCI

R.E. LUNA, Sandia Laboratories, *Albuquerque, New Mexico* 87115 (E(29-1)-789)

Project Da Vinci is a collaborative program of instrumented balloon flights to elucidate the chemical and physical behavior of air pollutants on a time scale of days over distances of hundreds of kilometers from pollutant sources. To date, there have been three manned flights in the series. The first, DV I, demonstrated the feasibility of using a large instrumented balloon for investigating the long distance transport and transformation of air pollutants. The data collected characterized the relatively clean air of the arid Southwest. DV II and DV III were launched during the spring and summer of 1976 from the St. Louis area to follow the St. Louis mixed urban/industrial plume to the east. More than a dozen research groups from various government laboratories, universities, and independent research organizations participated in these experiments. Future plans for Project Da Vinci involve the development of unmanned, computer-controlled balloon systems to serve as Lagrangian air parcel markers, and as Lagrangian measurement platforms. The lower cost and greater flexibility of these systems are expected to greatly enhance their usefulness to research efforts devoted to the understanding of pollutant behavior, and of atmospheric processes in general.

RESULTS: The data from the summer 1976 experiments are presently being analyzed. During DV II, long distance transport of ozone was observed with very little dilution or decay from chemical reaction at night. Vertical concentration profile measure-

ments by aircraft, ground level measurements by mobile van, and mobile acoustic sounder measurements documented the transport processes affecting the elevated ozone layer. Interesting insights were also obtained with regard to sulfur chemistry by elemental analysis of particulate samples, ESCA, and tandem filter techniques.

SUPPORTED BY U.S. Dept. of Energy, Div. of Biomedical & Environmental Research

5.0026, IN-HOUSE AMOS SUPPORT
D.W. HANSON, U.S. Air Force, Rome Air Development Ctr., *Rome, New York* 13440 (DF707210)

The objective of this effort is to completely characterize atmospheric parameters which effect optical propagation at the ARPA Maui Optical Station (AMOS).

Atmospheric affects on optical propagation can be classed as either intensity or phase distortions. Molecular absorbtion and scattering, fog, clouds, etc., are examples of atmospheric effects which change the average intensity of an optical signal, although phase distortion is also associated with some of these phenomena. Temperature turbulence, i.e., small changes in temperature over short distances, is the predominant factor in causing optical beam phase distortion. Phase distortions will create flucuations in the temporal and spatial intensity function of an optical signal, but the average intensity of the signal will not be affected. The atmospheric parameters which affect average optical signal intensity will be measured separately from those which affect the optical signal phase. Average intensity affects will be characterized by developing probabilities for a clear line of sight (CLOS) for various azimuth and zenith angles vs. the time of day and time of year. A contractual effort with Avco Everett Research Labs (AERL), J.O. 26460306, C/N F30602-75-C-0235, will provide data on atmospheric attenuation at infrared (IR) wavelengths. Phase effects will be characterized by measuring the temperature turbulence structure constant, and/or the optical propagation structure constant, versus altitude above AMOS. Such turbulence profiles will be measured at various times of the day and times of the year to determine their statistical behavior. From the profiles many optical propagation parameters can be calculated. The veracity of the profiles will be checked by measuring optical propagation parameters independently at the same time that the profiles are measured. The directly measured values will then be compared to the values calculated from the profiles. A contract with AERL, J.O. 26460115 C/N F30602-75-C-0012, provides for collection of data at AMOS and reduction of the collected data at either AMOS or Everett, MA.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Rome Air Development Center

5.0027, ISIS II DATA ANALYSIS
D.J. WINNINGHAM, Univ. of Texas, Graduate School, *Dallas, Texas* 75230 (DF278670; F19628-76-C-0005)

AF function - communications and detection. Deficiency - understanding ionospheric effects of particle precipitation in the arctic which degrade communications in that region. Objective - investigate the effects of auroral particle precipitation, measured by the ISIS-II satellite, on the ionization balance of the high-latitude ionosphere. How research contributes - this research effort is conducted to establish direct relationships between incident particle fluxes and specific features of the high-latitude ionosphere which result from these particles. A description of optical and plasma properties of the ionosphere from the measurement of particle fluxes, and the behavior of these properties during substorms, will lead to more effective and adequate interpretation of the satellite measurements and enhance remote sensing capabilities. Analysis of soft particle spectrometers data from the ISIS-II satellite also provides a framework for data collected by the AFGL Airborne Ionospheric Observatory.

Assemble and interpret ISIS-II soft particle spectrometer data to specify the structure of the ionosphere in the region of the auroral oval and f layer trough. Reduce particle data taken during selected aircraft periods for correlation with DMSP auroral photos and aircraft data. Investigate ability to use 6300 Angstroms photometer data as an indicator of FOF2 in the polar trough region.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0028, MAGNETOSPHERIC CURRENT SYSTEMS AND RESULTANT MAGNETIC VARIATIONS
A.J. DESSLER, Rice University, Graduate School, *Houston, Texas* 77001 (DF248260; F19628-77-C-0005)

AF function - operation of systems for communications, detection, surveillance, guidance, and navigation. Deficiency - system performance is degraded during severe geomagnetic disturbances that produce extreme departures from the normal conditions in the propagation environment. Objective - investigate methods for real-time predictions of changes in the magnetosphere-ionosphere system and determine how to infer the state of the magnetosphere with data from the magnetometer network and other data that will be continuously available. How research contributes -development of methods for prediction of changes in the magnetosphere-ionosphere system will permit accurate and reliable forecasts of geomagnetic activity. Such forecasts will enable system operators to take appropriate measures to lessen the impact of disturbances on military operational capability.

The program will involve detailed computer simulation of selected observed events in the inner magnetosphere, particularly magnetospheric sybstorms and the main phases of magnetic storms. Additionally, a comparison will be made between magnetic signatures recorded by the AF Geophysics Laboratory magnetometer network and those generated in the computer simulation -- signatures useful for predicting sub-storm timing and intensity. The computer simulation will provide a quantitative three-dimensional picture of the configuration of the inner magnetosphere during an event. Electric current distribution in the magnetosphere-ionosphere system will be computed as a function of time permitting the determination of corresponding surface magnetic-field perturbations.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

5.0029, REMOTE SENSING FOR SPECTRAL ANALYSIS OF SOIL AND WATER CONDITIONS AND PROBLEMS
C.L. WIEGAND, U.S. Dept. of Agriculture, Soil & Water Cons. Res. Div., *Weslaco, Texas* 78596 (0040968; 7202-20762-001)

OBJECTIVE: Develop fundamental information on the reflectance and emission characteristics of plants and soils, and test small data batches from electronic and optical mechanical systems aboard aircraft and spacecraft for detecting and assessing agricultural problem conditions.

APPROACH: Analyze seasonal changes of crops, discriminate among them, and estimate the acreages of selected crops in Hidalgo County using the Earth Resources Technology Satellite (ERTS) 4-channel scanner digital magnetic tape data. Determine whether differences in chlorophyll concentration in grain sorghum can be detected in ERTS data. Compare ERTS near-infrared reflectance with ground observations of leaf area index (LAI) and with predictions of an analytical model for determining plant vigor (cropland) and animal carrying capacity (rangeland). Complete study on optimal film types for soil mapping. Determine the influence of leaf maturation on reflectance of radiation over the 2.5- to 40-mum wavelength interval. Investigate procedures required to map saline soils by use of SKYLAB multispectral and photographic data.

PROGRESS: Reflectance (and absorptance) of plant leaves in the 0.4 to 2.5 mum wavelength interval was studied to determine best wavelengths to detect lead toxicity and ozone damage, to distinguish succulent from woody species, to detect silverleaf sunflower, to determine wheat vigor, and to distinguish wheat plants from soil. Soil-tillage-straw treated plots were also studied for distinguishing crop residue from soil as might be important in preventing soil erosion by wind. A procedure has been developed so that LANDSAT scenes can be computer line printer-mapped to meaningfully display vegetation density and soil conditions without prior knowledge of local crop and soil conditions. Thermal maps of the Rio Grande Valley based on NOAA satellite data show variations in temperature across the area. Spectral models developed and relations discovered between leaf area index, plant

population, ground cover, and plant height and LANDSAT digital counts have advanced the understanding of the spectral response of immature crops and the vegetative vigor of crops that will prove helpful in relating space observations to crop yields. The green biomass (forage productivity) of rangeland has been estimated from LANDSAT data, and the range sites have been discriminated for an 81,000 hectare study area.

SUPPORTED BY U.S. Dept. of Agriculture, Agricultural Research Service, Subtropical Texas Area

5.0030, REMOTE SENSING OF SOIL MOISTURE
A.O. POULIN, U.S. Army, Remote Sensing Center, *Fort Belvoir, Virginia* 22060 (DA0N8005)

To investigate the effects of vegetation on the diurnal range of surface (radiometric) temperature for assessment of its effect on the remote observation of soil moisture.

Surface temperature, soil moisture and vegetation observations will be made at established test plots during growth and maturation of selected vegetation. Meteorological and radiometric observations will be made for correlation purposes.

SUPPORTED BY U.S. Dept. of Defense, Office Chief of Engineers, Corps of Engineers

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, MAINTENANCE OF FLYING SKILLS FOR TAC AIRCREWS
J.C. REED, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF222880)

To develop a procedure which operational training personnel can use to determine the content of a continuation training program. The way in which specific training tasks contribute to the proficiency of certain skills will be studied. The end product should provide guidance to an operational training team for developing a continuation program that integrates the aircraft, simulator, procedural and part-task trainers, and other training devices.

AFHRL/FT will communicate with operational tactical squadrons to determine the nature of continuation programs. Task frequency data will be collected to document what is presently being done during squadron sorties. A task taxonomy of tactical flying skills will be developed to relate specific task repetitions to the maintenance of specific skills. Task repetitions will be manipulated at operational units to determine the effect on skill level. These data will be used to specify the number of task repetitions in various types of training devices necessary to maintain flying skills for the tactical pilots.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0002, ACQUISITION OF FLYING SKILLS
G.B. REID, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF223280)

To investigate the relationships which exist in pilot training between stage of training, training task structure, and feedback of information.

Simulation devices will be used to investigate training variables in order to develop a model of flying skill acquisition. Studies will be conducted to investigate such things as length of training sorties, fidelity of training task related to criterion task, subject experience and interaction with aircraft sorties.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0003, THE DEVELOPMENT OF AN AUTOMATED OBJECTIVE PERFORMANCE MEASUREMENT SYSTEM FOR ASUPT
W.L. WAAG, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF221220)

The principal objective is the development of an automated objective performance measurement system to be used in training research employing ASUPT. Since positive transfer effects are assumed, it is possible to use measures of pilot performance in ASUPT as the criterion against which to evaluate alternative simulator hardware configurations and training strategies. A further objective is the development of an empirical data base reflecting performance standards of both experienced instructor pilots and students as they progress through the simulation training program. The scope of the effort is the development of measures for all flying phases of UPT which will be taught in ASUPT. The output will be a series of 'flying tests' directed toward the assessment of proficiency at various levels of training.

A criterion-referenced approach to pilot performance measurement has been adopted. It is assumed that superior maneuver performance manifests three characteristics: (1) accomplishing the criterion objectives as defined by the aircraft state parameters; (2) avoiding excessive rates and accelerations so that the maneuver is executed smoothly, and (3) accomplishing these objectives with the least amount of effort by minimizing control inputs. The development of the measurement system will require four phases: (1) definition of the criterion objectives for each maneuver in terms of a potential set of simulator parameters, (2) evaluation of the proposed set of measures for the purpose of validation and simplification, (3) specification of criterion performance by requiring experienced IPS to fly the maneuvers in question, and (4) the collection of normative data using students as they progress through the training program.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0004, PSYCHOPHYSIOLOGICAL CORRELATES OF ATTENTION AND TASK DIFFICULTY
E. LINDHOLM, Arizona State University, School of Liberal Arts, *Tempe, Arizona* 85281 (DF223350; F33615-77-C-0069)

To develop physiological measures of pilot attention and task load for use in flight simulation research studies. Ultimately these physiological measures will be used in conjunction with behavioral measures of pilot attention and task difficulty, in order to optimally structure flight simulation training programs and equipment.

Task difficulty will first be manipulated with standard information processing tasks which have reliable behavioral measures. The purpose of this phase is to determine the physiological responses which are most consistently related to behavioral responses. Later, behavioral and physiological measures will be taken with a secondary task technique combining two relatively simple information processing tasks which provide a more realistic approximation of actual aircraft flight.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0005, HUMAN PERFORMANCE EVALUATION OF MATRIX DISPLAYS
L. SCANLAN, Hughes Aircraft Company, *Culver City, California* 90230 (DF319800; F33615-76-C-0503)

The objective of this effort is to provide a comprehensive experimental evaluation of advanced matrix display technology in terms of the simulated image display parameters involved and their effects on human performance. In addition, evaluation techniques will be developed for quantifying and subsequently specifying the characteristics of matrix element displays. The functional relationships and techniques to be generated will provide the developers and users of advanced display media with critically needed design criteria and trade-off data to optimally implement this new matrix display technology.

A simulation will be developed which will allow a wide range of variables associated with matrix element displays to be evaluated in terms of angular subtense of targets at time of recognition. Response surface methodology will be employed to determine the effects of existing and projected state-of-the-art combinations of display parameters to achieve alternative levels of operator performance.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0006, VISCOELASTIC BEHAVIOR OF THE INTERVERTEBRAL DISC RELATED TO EJECTION SHOCK

W.G. KNAUSS, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DF046780; AF-AFOSR-3139-77)

AF function - the Air Force operational environment involves exposure to a wide variety of mechanical forces including flail and impact. The body in general and the musculoskeletal system particularly are adversely affected by these forces. This is of special importance in cases of ejection from high-performance aircraft where the probability of disabling injury is unacceptably high. Deficiency - the main mechanical function of the spine is to support the upper body and transmit the weight/force to the legs. The lumbar region is subjected to most of the load. One of the more common injuries is lumbar disc compression failure. A qualitative model for the mechanical behavior of the disc is needed. Objective - the overall objective of this research is to improve the knowledge of the physiology and mechanical properties of the human intervertebral disc. How research contributes - this work should provide essential information to understand the short duration, transient loading problems of the spinal discs and contributes directly to subarea 1.6 'mechanical forces' and will also be applicable to the fields of diagnostic, preventive and reparative medicine.

The researchers will delineate the inherent actions of the disc to mechanical load and define these physiologic and anatomical changes in terms of engineering parameters and constants.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0007, PHYSIOLOGICAL PERFORMANCE RELATED TO MULTIPLE STRESSES SUCH AS THOSE EXPERIENCED IN AIR FORCE OPERATIONS

S.M. HORVATH, Univ. of California, School of Letters & Science, *Santa Barbara, California* 93106 (DF025960; AF-AFOSR-2455-73)

AF function - the operation of AF weapon systems imposes on crew members' combined stresses from extremes in temperature, pressure, acceleration, discomfort and fatigue from protective clothing and equipment, and prolonged missions with altered work/rest cycles. Deficiency - biomedical technology to improve present operations and to provide design criteria for future systems is critically dependent upon advances in knowledge about the physiological effects and performance decrements and predictions of operators exposed to these combined stresses. Objective - these studies are primarily concerned with the biochemical and particularly the endocrine interrelationships to stresses utilizing new radioimmunoassay procedures. The conditions used are environmental including temperature and altitude, psychological, as monotonous monitoring of instruments, and exercise. How research contributes - results from these studies are in direct support of subarea 1.5 and programs at USAF/SAM and at AMRL.

A multidisciplinary group will investigate problems in human physiology in toleration of stresses particularly on vigilance, exercise and hypoemia emphasizing immunochemical procedures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0008, APPLICATION OF VOICE TECHNOLOGY IN AUTOMATED SYSTEMS

I. GOLDSTEIN, U.S. Navy, Human Factors Laboratory, *Orlando, Florida* 32813 (DN494002)

Develop techniques for improving quality control while reducing costs of training Navy personnel to perform control activity such as ground controlled approach (GCA), other surface-based controller tasks and certain mission control functions of naval flight officers. These jobs have in common the use of restricted, stylized, speech to guide a man-machine system. This project will examine the training value of systems which incorporate advanced technologies such as: (a) machine understanding of spoken commands; (b) automated adaptive instruction; (c) advanced computer programming structures; (d) advanced training requirements analysis.

Study the conceptual and technical feasibility by developing a laboratory version of a system for training students in the precision approach radar (PAR) phase of GCA. If the first stage is successful, extend concept to other phases of GCA and to other controller-type training situations. When appropriate, conduct validation studies in an operational training setting.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Training Equipment Center

6.0009, INVESTIGATION OF CERVICAL SPINE DYNAMICS

Y.K. LIU, Tulane University of Louisiana, School of Engineering, *New Orleans, Louisiana* 70118 (DF320340; F33615-76-C-0526)

The objective of this effort is to provide anatomical, structural and loading data on the human cervical spine for incorporation as part of a biological parameter data set into the dynamic head-spine computer model presently at AMRL/BBM. The data generated will improve the analytic predictive capability provided by the above-mentioned model by allowing detailed analysis of head-spine response (including potential injury assessment) during ejection from aircraft, aircraft crashes or other high-level impact loading of the human body, and while taking into account various external body constraints and head encumbrances.

A literature search for previous work, both experimental and theoretical, in the area of cervical spine dynamics will be performed. Segments of at least six human cervical spine specimens will be tested statically, dynamically and to failure for their axial, anterior-posterior and lateral loading characteristics. Care will be taken to ensure appropriate specimen selection to provide structural and loading data as characteristic as possible of Air Force flight personnel.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0010, PREDICTIVE MODELS OF HUMAN VISUAL PROCESSES IN AEROSYSTEMS

R.J. MANSFIELD, Harvard University, School of Arts & Sciences, *Cambridge, Massachusetts* 02138 (DF044250; F44620-76-C-0109)

AF function - in Air Force flight operations target acquisition activities, optical countermeasures, display scanning, reconnaissance photointerpretation and other activities are critical for mission success. In all of these activities man's visual processes are of vital importance. Deficiency - research is needed to specify the visual performance characteristics of man in terms compatible with evolving, complex man-machine systems. Present models of human visual processes have limited value for enhancing human visual performance during critical Air Force mission. Objective - the principal goals of the proposed research are to (1) analyze the functional capacities of human observers to detect, discriminate and evaluate visual patterns, and (2) synthesize experimental data in terms of a mathematical model of the human visual system that is both predictive of performance and consistent with known physiological mechanisms. How research contributes - the proposed research will permit the comprehensive determination of a wide range of visual parameters, and the models for human visual processes critical to Air Force missions will be extended.

The research as planned covers three stages of development that will include both theoretical modeling and experimental analysis. The plan is hierarchical in that the experimental analysis will build upon the quantitative models developed in a previous stage and will supplement the construction of models for that stage. Experiments will be directed toward resolving questions concerning light- and dark-adaptation as well as obtaining basic data on spatial interactions. The processes of hue perception and foveal fixation and tracking will be studied, and quantitative models for color vision and eye movement control will be analyzed. An interactive computer control of an optical simulator that includes a visual display system, a device for the precise and accurate tracking of eye movements, and appropriate calibration devices will be employed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0011, CHANGES IN THE ORGAN OF HEARING PRODUCED BY SOUND
D.J. LIM, Ohio State University, School of Medicine, *Columbus, Ohio* 43212 (DF322410; F33615-77-C-0512)

The purpose of this work unit is to examine changes in the auditory system produced by exposure to excessive sound. The effort will emphasize studies in the infrasound (1-20 Hz) region and long-term, low-level exposures at mid-frequencies (600-2000 Hz). Goal of the research is a reasonable hypothesis of the mechanism of injury production that provides a rationale for treatment and prevention. Results of this basic research are used in the AMRL applied technology program in establishing guidelines for limits of exposure and methods of protection from exposure to excessive sound. Ultimately this forms the basis for Air Force regulations governing exposure and protection criteria. Data are also used by the Environmental Protection Agency.

Infrasound exposures will be carried out only on experimental animals. Long-term, low-level exposures will be carried out on experimental animals and human volunteer subjects at levels which do not produce permanent changes in hearing. Techniques to be employed include light and electron microscopy of inner ear structures, electrophysiological measures of middle ear muscle activity and psychoacoustic measures of changes in auditory acuity.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0012, IN VITRO CHEMICAL CARCINOGENESIS AND CO-CARCINOGENESIS IN HUMAN CELLS INITIATED BY HYDRAZINE & POLYNUCLEAR COMPONENTS OF JET FUEL
G.E. MILO, Ohio State University, School of Veterinary Medicine, *Columbus, Ohio* 43210 (DF049220; F49620-77-C-0110)

AF function - the Air Force uses many unique chemicals and materials to obtain optimum performance of its aircraft and missile weapons systems. Strategic and tactical objectives call for the use of the most energetic compounds for ICBM and air-launch missiles. National legislative and regulatory controls on the use of energetic chemicals have necessitated a step-function increase in the need to define safe exposure limits and handling practices for these chemicals concurrent with the acquisition of the weapon system. Deficiency - there is a need to investigate mechanisms and to devise methodologies to predict, detect, measure and modify pharmacological manifestations of the unique chemicals and materials associated with USAF weapon systems in order to protect personnel from health and performance degradation. Research is needed to determine and identify actual molecular mechanisms of chemical carcinogenesis which could apply to chemicals other than hydrazine. Objective - examine the cytotoxic and carcinogenic potential of hydrazine and polynuclear hydrocarbons in synchronized and nonsynchronized normal human cells, investigate damage to cellular DNA by studying unscheduled repair kinetics and alterations in cellular associated DNA directed DNA polymerase activities, investigate, with oncogenic DNA and RNA virus, whether the suspect carcinogens act synergistically with these viruses to enhance virus transformation of human cells, investigate whether these chemicals activate endogenous RNA-C-type virus expression in human cells, determine whether these chemicals damage cellular DNA, providing additional sites for virus integration. How research contributes - this research contributes directly to subarea 1.9 'environmental protection and toxicological hazards,' RO 1.9.1.1.

This research will attempt to elucidate the mechanism producing changes in cell chemistry, DNA and RNA and to correlate this with the metabolic and biochemical state of the cells.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

6.0013, ASUPT G-SEAT CONFIGURATION SIMULATION
W.B. ALBERY, U.S. Air Force, Human Resources Laboratory, *Dayton, Ohio* 45433 (DF228040)

To investigate simpler g-seat hardware configurations for the purpose of describing a low-cost approach to g-cuing for future simulators. The results will be applied to the design of the advanced low-cost g-cuing system (ALCOGS) developed under project 1958-02-01. To validate the design of the ALCOGS or to identify ineffective components and suggest improvements.

The approach is to take advantage of the flexibility of the ASUPT g-seat software and to constrain bellows or groups of bellows such that larger surface areas for the seatpan and backpan can be simulated. The simplest approach will be to investigate a three-component seat compared to ASUPT's 32-component capability. Only the lap belt and two seat pin bellows will be actively driven. In driving the lap belt plus the two bellows under the buttocks, a very simple three-component g-seat will be simulated. From this basic configuration, additional seat and backpan configurations will be tried. In-house IPs will fly the different seat configurations and evaluate back configurations effectiveness in simulating g-cues as compared to the full-capability g-seat configuration.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0014, COMPASS EARS
L.L. GRIFFIN, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321000)

To provide human engineering criteria and design consultation in the design, development, test and evaluation of the Compass Ears project. The emphasis of this support is upon the specification and selection of information display and communications equipments. The design and evaluation of workspace arrangement and environment, operator safety and design for maintenance also receive significant attention. It is anticipated that experimental research will be required to provide viable solutions for the system information handling, processing and transfer within the system.

Application of human engineering design criteria, within the framework of MIL-STD-1472B, to the interfaces, processes and performance of the system and technical evaluation of research proposals to the program manager for solutions of the longer range information processing problems which require system specific research.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0015, COMMUNICATION MEASUREMENT SYSTEM
R.L. MCKINLEY, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321340)

Future requirements of AFR 161-35 and more powerful propulsion systems of current and future aircraft call for research and evaluation of many different communication systems and devices. The objective of this effort is to develop and implement a research and testing system to simulate an operational communication environment and to develop standard research and testing procudures, and data reduction software for evaluation of AF voice communication systems and devices. This effort will support ASD life support SPO's and weapons systems development SPO's.

The approach is to develop a laboratory aircraft voice intercommunication system which is capable of reproducing a realistic and valid simulation of the operational environment. This will include a multi-station intercommunication system, a respiration system, appropriate terminal equipment (helmets, masks, headsets, etc.). Accurate simulation of the spectra and levels of specific weapons systems air and ground noise environs, radio static, auditory warning signals if feasible and various communication situations such as quiet to noise, noise to noise, and the like. The final experimental procedures will be standardized and software developed to provide descriptions of communication effectiveness in terms of the variables under investigation.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0016, ADVANCED RPV SYSTEMS SIMULATION
R.G. MILLS, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321230)

The objective is to apply computer simulation methodology to the analysis and design of Air Force RPV systems. Technology gaps have been identified that relate to the assessment of alternative RPV systems performance under (a) various sensor subsystems for reconnaissance and weapon delivery, (b) various techniques for processing imagery and reducing bandwidth, and (c) various general system conditions such as manned RPV mix technical scenarios, RPV guidance parameters, etc. Support documentation for these technological gaps is in development goals C-3-2, RI-4, RI-5, and MS-4, AMRL/ASD RPV SPO memorandum of agreement (24 Oct 75), drone near real-time reconnaissance PMD (R-R5039(2), 30 Oct 75), advanced RPV PMD (R-55011(2), 6 Jun 75), RPV mission control system PMD (R-R-5024(2), 5 Dec 75), jam resistant imagery transmission (draft ADP, AFAL/AAD, Jun 75).

The approach is to develop a computer simulation of an RPV system that will serve as a test bed for obtaining system performance data. The computer simulation will employ teams of operators performing functions that they would normally perform in a real-world system in real-time. The computer simulation is to be as complete a representation of an RPV system as possible, thus necessitating the simulation of a large number of machine and environment elements (or subsystems) and their relationships over real-time. The simulation must also be flexible such that a variety of alternative RPV systems and subsystems (e.g., sensors) can be tested. The products of this work are (a) general technical data relating to expected RPV system performance under testable conditions (e.g., performance under alternative mission scenarios, operating procedures, etc.), (b) expected RPV system performance data when alternative imagery processing techniques are employed in the system, and (c) expected system performance when alternative reconnaissance sensors are employed in the system. Products are in the form of technical reports and messages transmitting specific requested data or consultation information.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0017, MODEL OF SECOND-STAGE SIGNAL PROCESSING FUNCTION OF AUDITORY SYSTEM

T.J. MOORE, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321470)

This effort has as its goal the development of innovative data processing techniques. These techniques are needed to handle, on a real-time basis, the wealth of data generated by Air Force reconnaissance and communications systems.

This work unit will transition the results of neurophysiological studies done under 2312-V4-15 and 2312-V3-10 into networks tested on the CXC computer. These test networks provide means of evaluating the various parameters manipulated for feature extraction in an innovative signal analysis system.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0018, OPTICAL PROPERTIES OF WINDSCREENS

R.C. SEID, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF321110)

To develop new measurement techniques for evaluating cockpit windscreen optical characteristics. To measure and quantify the optical characteristics exhibited by experimental and actual a/c windscreens, using both existing and new optical measures. To analyze the optic performance of the design windscreens for the F-111 and B-1 a/c, using computer ray-tracing techniques, assist in relating the optical characteristics of these, and similar, transparencies to specific functional effects on the human visual system (wu 71841803). The ultimate product of this work unit will be to recommend a specific set of optical measures that will be used in acceptance testing of a/c windscreens. This effort supports AFSC development goal MS-4.

Historically, a number of optical tests have been devised in an effort to quantify the optical characteristics of windscreens. None of these measures has proven to be infallible. In the previous work unit (71841204) several new measures of windscreen optical quality were being explored. These included: multiple imaging, optical Fourier analysis, angular deviation, binocular disparity and birefringence coloration. By comparing optical measures made on the windscreens with pilot acceptance and/or visual performance (see WU 71841803) it will be possible to determine which of these optical tests correlates with vision. Predistorted panels have been fabricated to be used in relating optical measures to vision. Windscreens and new panels have different characteristics and geometrics will be used during the course of this work. The windscreen measurement lab and the image metrics facility will be used in accomplishing this work. Disciplines involved are optics, physics, and experimental psychology. Field data from F-111 windscreens will be obtained and compared with the optical measures developed for the previous work unit. Computer ray trace of the F-111 and B-1 windscreens will be accomplished for determining design-inherent angular deviation, binocular disparity and multiple imaging. This will be compared with actual measures to determine how much of the problem is due to manufacturing and how much is inherent in the design.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0019, VARIABLE IDENTIFICATION

G.J. VALENTINO, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF322460)

Establish a data base on the soviet ZSU-23-4 antiaircraft artillery (AAA) weapon system. Data for simulation is needed on, but not limited to, the radar, gun, and fire control computer dynamics, system configuration, modes of operation, and crew training procedures.

Intelligence data will be acquired through such agencies as AFSC/FTD, TAC/ADTC, USAF/SA, and US Army/Foreign Science and Technology Center, and others.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

6.0020, DETERMINATION OF PHYSIOLOGICAL CRITERIA FOR DESIGN OF NAVAL AIRCREW VISUAL DEVICES

G.T. CHISUM, U.S. Navy, Crew Systems Department, *Warminster, Pennsylvania* 18974 (DN581104)

To determine the physiological capabilities and limitations of the human visual system under airborne operational conditions requiring the use of visual display devices and specify the criteria to be satisfied in the design of visual display devices. The requirement for this work was established by new research code, PA-6 of the FY 1974 Naval Aviation Biomedicine/Human Effectiveness Technical Workshop Report.

Physiological assessment of the visual system in terms of adaptation, acuity, accommodation and sensitivity will be coordinated. Basic laboratory techniques and novel techniques as required will be used to assess the visual capabilities. Criteria will be established for use by display designs.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Medical Research Institute

6.0021, HYDROXYLATED CONJUGATED & EXCITED-STATE DERIVATIVES OF CELLULAR METABOLITES IN BODY FLUIDS AS STRESS INDICATORS

B.D. POLIS, U.S. Navy, Crew Systems Department, *Warminster, Pennsylvania* 18974 (DN333005)

To determine unique derivatives of cellular metabolites and bioregulatory factors like o-hydroxy hippuric acid in the urine of humans exposed to stressful aerospace enviroments. The goal is to achieve predictive indices of stress intolerance which will reveal the exhaustion of adaptive mechanism and the onset of pathology.

Thin-layer and high-pressure liquid chromatography will be used in conjunction with ESR and fluorescence spectrophotometry to detect and quantitate the organic solvent soluble components extractable from the acidified urine of control and stressed military flight personnel. Results will be correlated with other stress indicators like blood phospholipids to achieve a biochemical indication of stress pathology.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Air Systems Command

6.0022, CLINICAL FLIGHT MEDICINE EVALUATIONS
R.S. DRYDEN, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF323120)

To provide direct support to HQ USAF/SG and the surgeons of the major commands through clinical flight medicine evaluations emphasizing dynamic patient testing of aircrew members with medical findings or disorders which are a potential threat to flying safety and which preclude continued performance of flying duties to perform detailed aeromedical evaluations not elsewhere available and recommend clinical and aeromedical disposition to the referring medical authority IAW AFR 161-23, to enlarge the technical data base regarding disorders in the aircrew population which supports the research programs and other elements of project 7755.

Initial patient aeromedical evaluations will be charged against this work unit. Certain necessary and directed (AFR 161-23) re-evaluations not covered under existing protocols/work units will also be included here.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0023, MAINTENANCE OF AIR FORCE HUMAN RESOURCES DATA BASE
C.C. FRESNE, U.S. Air Force, Human Resources Laboratory, *San Antonio, Texas* 78236 (DF232750)

Continuation of 63230101 - to collect, document, maintain, and update automated personnel data for Air Force officers, enlisted personnel, and the civilian work force. To organize these data in readily accessible data bases for support of research studies of the personnel system.

Automated standard and command-unique personnel data files will be acquired, edited, and reformatted. Data for all military accessions, flying and technical training, reenlistment and separations, and strength files will be included. Nonautomated documents containing performance and evaluation data will be acquired and converted to machine-compatible form. Milestones - feb 76 - revalidate requirements for continuing receipt of approximately 30 source files including UAR/UOR Active/Reserve/ANG (each semi-annual), technical training (quarterly), basic military training (monthly), OTS (annual), flying/ navigator training (each annual), etc. Feb 76 - complete processing of Jun 75 OTS historical master file. Mar 76 - complete CY 75 update of basic military training file. Mar 76 - complete processing of Dec 75 UAR/UOR Active/Reserve/ANG and airman reenlistments and losses files. Mar 76 - complete processing of Jun 75 UOR separated officers file. Mar 76 - complete processing of CY 75 technical training file. May 76 - complete CY 75 preparation of AFOQT data. Sep 76 - complete processing of Jun 76 UAR/UOR Active/Reserve/ANG data. Sep 76 - complete processing of Dec 75 UOR separated officers file. Oct 76 - complete processing of Jun 76 OTS historical master file. Oct 76 - complete processing of Jun 76 AFROTC applicants/advanced/commissioned losses files.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Human Resources Lab.

6.0024, CHEMICAL CHARACTERIZATION OF POLYCYCLIC ORGANIC MATERIALS IN AIR BASE
C.L. GIANNETTA, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF320870)

Develop methodology for sampling and analysis of polycyclic organic materials (POM) that would assist AF labs such as the Environmental Health Lab in assessing the health impact of POM in air base environments.

A review of previous work will provide background for evolution of a unified scheme for sampling and analysis of POM. The concern will be for particulate POM (PPOM), vapor phase POM (VPOM) and for POM in aqueous environments. Some areas to be explored include: (1) PPOM sampling on glass fiber filters, (2) VPOM sampling on porous polymer beads in solvents and in cryogenic traps, (3) extraction of POM from filters by ultrasonic solvent extraction, (4) gross separations by compound class (aromatics, paraffinics, oxygenates, etc.) and use of this kind of separation to give low-cost sampling index to POM contamination, (5) final separation and identification by gas chromatography (GC), high-pressure liquid chromatography (HPLC), GS mass spectroscopy (GCMS) and fluorescence spectroscopy and (6) field evaluation of lab-demonstrated techniques. Prior progress in this effort has been documented under work unit 71641620. This new work unit implements new technology planning objective alignment as directed by HQ Aerospace Medical Division.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0025, EAR LOBE CREASE - RELATIONSHIP TO CORONARY ARTERY DISEASE IN HUMANS
H.H. HANNA, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321910)

To determine the incidence of significant ear lobe creases in various age groups of selected apparently asymptomatic individuals and to verify the reported correlation of ear lobe creases with coronary artery disease.

Patients referred to the Aeromedical Consultation Service will have a color photograph made of each ear lobe to document the presence or absence of skin creases. In those individuals who later have cardiac catheterization with coronary angiography, correlation of ear lobe creases with coronary artery disease will be determined. Those individuals who do not have cardiac catheterization will comprise the control group for incidence of ear lobe creases. This work was formerly documented under 7755-08-04.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0026, AVIATOR'S BREATHING OXYGEN CONTAMINANT ANALYZER
K.G. IKELS, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322290)

Headquarters, Air Training Command, issued required operational capability NR. ATC 2-72 in June 1972 for a portable oxygen contaminant analyzer. This ROC is for an immediate analysis capability for oxygen samples taken from aircraft following an inflight physiological incident where aviator's breathing oxygen is implicated. The ATC ROC was validated by HQ USAF on PMD NR. R-Q-3-013-(1), dated 21 July 1972. The objective of this effort is to develop a portable contaminant detector for base-level personnel to perform oxygen analysis in accordance with use limits specified in T. O. 42B6-1-1.

Feasibility of a miniaturized portable infrared analyzer for field detection of use limit contaminants was demonstrated in OT&E program conducted in FY 74. The instrument transitioned to engineering development in late FY 74 and is now managed by the ASD/AEL under endeavor AO258. Major effort in FY 76 was the design modification and systems procurement. Operational T&E will be conducted in FY 77 and initial inventory deployment in FY 78. Previous accomplishments in this work area are documented under work unit 71641601. This effort is being transferred to implement a new technology planning objective as directed by HQ Aerospace Medical Division.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0027, DT&E SUPPORT TO TAWC AIRCREW EQUIPMENT TEST
R.C. LIGDAY, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF320370)

This effort provides expertise and instrumentation to determine the quality and build-up of toxic gases in and around AF weapons systems during DT&E and IOT&E at TAWC, Eglin AFB, Florida.

The USAFSAM will provide, for various applications, the instrumentation to detect and quantitate toxic gases evolved from various Air Force weapons systems. The instrumentation and

techniques to be used have been developed during USAFSAM studies at Eglin AFB (7930-10-16) and Edwards AFB (7930-10-10).

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0028, RADIOFREQUENCY RADIATION EFFECTS ON BIOCHEMICAL SYSTEMS IN THE CENTRAL NERVOUS SYSTEM

J.H. MERRITT, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF318800)

The Department of Defense Triservice Electromagnetic Radiation (EMR) Bioeffects Research Program describes the central nervous system (CNS) as the 'singularly most important area where there is evidence that EMR interacts with biological systems.' The objective of this effort is to quantitate the radiofrequency (RF) EMR effects on biochemical events subserving nerve transmission in the CNS. The information obtained will be applied to establish more appropriate safety standards for personnel working in close proximity to AF RF emitters.

The effects of RF radiation on the CNS, specifically on a specialized function of the neuron, namely synaptic transmission, will be studied. It is probably true to say that every cell in the brain is connected, directly or indirectly, to every other cell by chemical switching systems (synaptic transmission). This effort will attempt to quantify changes produced by RF energy in these chemical systems, determine thresholds for frequency and power density, and interpret these changes in terms of the expected effect on man in AF operational environments.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0029, AIRCREW PROTECTIVE HELMETS - ADVANCES IN TRI-SERVICE/INTERNATIONAL

R.L. STORK, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322620)

During FY 77, OT&E of a new, lightweight, aircrew, flight helmet will occur during the AIMVAL/ACEVAL exercise. Four prototype helmets will be rated by the aircrews during the exercise. The objective of this work unit is to follow the OT&E monitoring the experience gained with the helmet.

OT&E data will be used to compile a technology base from which biomedical criteria may be established for application to future aircrew protective headgear production programs.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0030, TEST AND EVALUATION OF A MOLECULAR SIEVE OXYGEN GENERATOR

R.L. STORK, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322940)

Considerable amounts of support and maintenance are required by the use of liquid oxygen (LOX) as the oxygen source on-board aircraft. The high altitudes at which USAF aircraft operate necessitate an aircraft oxygen supply that can be used to supplement the aircrew's breathing mixture for the duration of the flight. The current method uses a LOX supply, LOX converter, oxygen manifolds and regulator(s). Correspondingly, ground support is frequently required and periodic maintenance is inevitable. Great advantages, including manpower savings, increased system safety, and improved bare base operational capability, will be gained by providing an on-board means of inflight oxygen generation. A variety of methods for inflight oxygen generation have been proposed; of these, molecular absorption is the most attractive. The objective of this work unit is to explore the environmental and engineering variables which affect the performance of a molecular sieve oxygen generator, thus providing a technology base from which the performance of the MSOG can be optimized. These variables include, but are not limited to, absorbent material, absorbent bed physical dimensions, absorbent bed cycle time, inlet pressure and temperature, and outlet flow demand.

A MSOG is being obtained from NADC. Once received, environmental testing will be conducted. A matrix of test conditions including altitude, outlet flow rates and inlet pressures (40, 60, 80, 100 and 120 psia) will be explored. During these tests nitrogen, oxygen and argon levels will be continuously monitored. Flow rates and pressure drops through the system will be measured. These evaluations are essential prior to designing and interfacing new oxygen regulators and oxygen delivery components.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0031, EDG/ERG/DARK ADAPTOMETRY

T.J. TREDICI, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF321690)

To provide comprehensive electrodiagnostics for night vision evaluation in USAF aircrew members referred to USAFSAM, to gain insight into the processes of night vision disorders through the use of electrophysiology, to advance understanding of basic visual mechanisms objectively with the use of electrical technology.

Application of current technology using using averaging computers, storage oscilloscopes, RF shielded rooms, and other equipment will be continued in evaluating visual physiology. Improved stimuli (integrating spheres) and recording devices (electrodes) will be utilized to advance the quality and scope of collected data. Research into underlying visual mechanisms and processes will be pursued. Efforts previously under work unit 7755-09-04.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0032, AUTOMATED PATIENT RECORD SYSTEM

M.E. WOMBLE, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF322080)

To determine the feasibility of incorporating the USAFSAM central waiver repository file into a system capable of giving medical personnel in the Surgeon General's office instantaneous access to the file on a 24-hour basis.

A smart-disc system capable of automatically receiving requests and corrections, sorting files, and transmitting desired records will be designed. Concurrently, with the development of the disc-systems, an intelligent terminal will be designed which will automatically communicate with the disc-system. Both the disc-system and the terminal will be built and evaluated, with the terminal at Randolph AFB and the disc system at Brooks AFB. The terminal will then be installed at the Surgeon General's office and further evaluated. This is a new effort for fiscal year 1977.

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0033, EFFECTS OF INSPIRED GASES ON PULMONARY PATHOLOGY AND FUNCTION

R.J. KING, Univ. of Texas, School of Medicine, *San Antonio, Texas* 78284 (DF318650; F41609-75-C-0023)

In many Air Force operational environments personnel are required to breathe oxygen concentrations higher than that of air. Current diluter demand regulators normally supply 30 percent oxygen at ground level and some regulators supply as much as 40 percent oxygen at ground level, increasing to 100 percent oxygen at 28,000 ft. Aircrews are exposed to 100 percent oxygen at ground level during prebreathing for certain reconnaissance flights. Navy pilots routinely use 100 percent oxygen at all flight altitudes. Aviators breathing pure oxygen at reduced pressure are particularly susceptible to absorptional atelectasis when airway obstruction occurs during high acceleration. Exposure of man to pure oxygen even at normal atmospheric pressure rapidly alters lung function and may cause pulmonary damage. Such exposure may modify pulmonary cellular elements and surface active material, thereby degrading pulmonary function and increasing susceptibility to conditions such as respiratory infection and pulmonary atelectasis. The purpose of this effort is to develop a sensitive method which will enable unequivocal definition of the cellular mechanisms by which high oxygen concentrations affect the

function of pulmonary tissues. This method will also permit evaluation of the reversibility of the effects caused by repeated short-term exposures to high oxygen concentrations as operationally encountered. Potential sites of morphologic or physiologic derangements in pulmonary tissues, resulting in degradation and progressive impairment of pulmonary function over the range of breathing mixtures encountered in the aerospace environment, can then be identified. These data will be applicable to life support system design and the development of protective measures to reduce potential pulmonary damage and impaired gas exchange in the lung.

The lung is comprised of over 40 different cell types and it has not yet been possible to differentiate direct effects of oxygen on the metabolism of surface active material from secondary effects resulting from other cellular damage and subsequent transudation into the alveolar space of fluids from the circulation or from damaged cells. Such fluids could interfere with the ability of surface active material to manifest its surface properties even though its own metabolism were unimpaired. (Text abridged.)

SUPPORTED BY U.S. Dept. of Defense, Air Force, School of Aerospace Medicine

6.0034, BIOTHERMAL COMPUTER RESEARCH FOR PREDICTION OF AIRCREW RESPONSE TO THERMAL EXTREMES

A.C. BROWN, Univ. of Washington, School of Medicine, *Seattle, Washington* 98122 (DF316730; F33615-72-C-1237)

This contract is an effort to define and model aircrew and ground crew response to thermal stress to predict the thermal strain produced by Air Force operational environments. Its results will enable ready selection of design criteria for thermal protection of air and ground crews in manned weapons systems and support software. It will create a physiological data base for weapons systems designers to use in computing hardware/software trade-offs. The work to date has been the construction of a comprehensive biothermal model based on known physiological and physical control of heat distribution in the body and on data in the existing literature.

The work under this contract will improve this model and adapt the model for use on a typical minicomputer, this will allow easy use of this tool by any interested Air Force research organization, as well as its modification for use in solving special-purpose operational problems.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Aerospace Medical Research Lab.

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, INVESTIGATION OF DATCOM PREDICTION METHODS

C.R. BAUER, McDonnell Douglas Astro. Co., *Long Beach, California* (DF139630; F33615-77-C-3034)

A continuing effort is required to improve DATCOM coverage by refining existing methods and adding new techniques in concert with rapidly advancing technology. The objective of the present effort is to conduct a comprehensive review of the DATCOM and related aerodynamic technology, both to uncover deficiencies and imbalances in current DATCOM coverage and to gain information for efficiently planning future exploratory development.

The approach will consist of (1) a detailed, section-by-section review of the DATCOM to isolate errors and identify shortcomings and omissions in current coverage, (2) an investigation and evaluation of specific techniques for predicting the aerodynamics of missiles and the high-lift characteristics of close-coupled canards, and (3) the identification of other areas which appear to be amenable to solution at the present time, based on a survey of aerodynamic methods and data in the currently available literature.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

7.0002, APPROXIMATION THEORY - COMPUTATION OF RATIONAL APPROXIMATIONS AND APPROXIMATION WITH SIDE CONDITIONS

G.D. TAYLOR, Colorado State University, School of Hum. & Soc. Sci., *Fort Collins, Colorado* 80523 (DF041210; AF-AFOSR-2878-76)

AF function - the design of structural components for aerospace vehicles. Opportunity - rational approximations techniques are very effective in the solution of applicable problems of interest to the Air Force. Objective - this effort will investigate rational approximations, approximation with side conditions and application of the theory to application problems. How work contributes - computational techniques may be developed for solving problems which cannot be effectively solved with available methods.

This research effort will involve the calculation of good approximations in the uniform norm which can be generalized to functions in several variables and to approximations with side conditions. Efforts will include approximation of EXP (-X) to construct numerical methods for solving linear parabolic partial differential equations. Application of approximation theory with side conditions in designing non-recursive digital filters will be investigated. The uniqueness and error of approximation of linear approximations with side conditions will also be studied. Efforts will be spent to develop various curve fitting routines that make use of uniform approximation theory with side conditions. The long-range goal is to develop some viable adaptive fitting routines for problems in several variables using uniform approximation theory.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

7.0003, DEVELOPMENT OF DSF SOFTWARE TO SUPPORT THE SATELLITE PROGRAM

UNKNOWN, Computer Sciences Corporation, *Silver Spring, Maryland* 20910 (FA77NA-4011/1; FA160243 (TRAIS NO.))

Develop computer programs which provide the software interfaces between the Digital Simulation Facility (DSF) and the Aeronautical Satellite (AEROSAT) Communications Support Facility. The AEROSAT Support Facility consists of a Communications Earth Terminal to provide access to the space segment (satellite), a Communications Processing and Switching Center (CPSC), and an Experimental Automated Oceanic Control Center (EAOCC). The functions of the CPSC are the management and control of the assignment and utilization of AEROSAT channels to provide voice, data, and surveillance communications services for airborne and ground users in an oceanic air traffic service. Provision of these functions includes: (1) monitoring and interpretation of signal information to effect proper channel switching, (2) queuing and routing of communications.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

7.0004, ATCRBS MONOPULSE PROCESSING SUBSYSTEM AUTOMATED RADAR TERMINAL SYSTEM INTERFACE

UNKNOWN, Input Output Computer Srv. Inc, *Cambridge, Massachusetts* 02138 (FA77WAI-743; FA160417 (TRAIS NO.))

The interface unit hardware is intended to be used at those sites that have the basic ARTS III IOP. It will interface with a standard Type A channel in the IOP. At facilities that have the new IOP equipment, a CMC will be used instead of the interface unit and will interface with an ESI channel. The software provided in this effort shall be compatible with both the interface unit/Type A channel input and the CMC/ESI channel input usages. It shall be capable of processing data from either input channel without software modification other than controllable programmed switches.

SUPPORTED BY U.S. Dept. of Transportation, Federal Aviation Admin.

7.0005, SOME TECHNIQUES OF DATA ANALYSIS IN FLIGHT CONTROL AND RELATED PROBLEMS
P.R. KRISHNAIAH, Univ. of Pittsburgh, Graduate School, *Pittsburgh, Pennsylvania* 15213 (DF139930; AF-AFOSR-3239-77)

Part of AFFDL's responsibility is the development of advanced flight control systems and crew stations. In order to compare candidate flight control systems and crew station components, simulations and flight tests are conducted in which pilot performance is measured. However, there is no single measure of pilot performance, thus requiring the collection of many kinds of performance data and their analysis by means of multivariate statistical techniques. The objective of this work effort is to evaluate available multivariate statistical techniques for simultaneous comparison of mean vectors and the development of computer programs to implement these techniques.

Seven currently available techniques will be evaluated by the contractor as to their robustness to violations of the assumptions of homogeneity of the population covariance matrix and the normality of the multivariate distribution. The most robust technique will be implemented by means of computer programs which will be available for use by AFFDL personnel.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Flight Dynamics Lab.

7.0006, INVESTIGATION OF STOCHASTIC CONTROL SYSTEMS
H. KUSHNER, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DN123377; N00014-76-C-0279)

Modern weapons systems and automatic ship and aircraft steering systems require more powerful mathematical methods of solution and analysis of complex control systems. It is the purpose of this research to study control problems in which statistical noise is present. This can be taken to represent uncertainties in the atmospheric or ocean environment, exact values of important parameters, etc.

The principal investigator will seek computational algorithms for computing optimal stochastic controls or useful approximations to them. This work will use techniques from a wide range of mathematical areas including probability theory, differential equations, and numerical analysis.

SUPPORTED BY U.S. Dept. of Defense, Navy, Office of Naval Research

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, TIME-OF-FLIGHT MOLECULAR SPECTROSCOPY
W.E. LAMB, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (DF039720; AF-AFOSR-2864-75)

AF function - this research contributes to RO 6.3, electromagnetic weaponry. Opportunity - the search for new lasing media will be facilitated if potential energy diagrams of candidate molecules are known. Objective - to make velocity-resolved studies of the production of metastable atoms from dissociating molecules and their de-excitation by collisions with other atoms and molecules. Contribution - this research has the capability of establishing the potential energy diagrams of a number of diatomic molecules of interest to new lasers.

A time-of-flight spectrometer is being used to obtain high-resolution electron-bombardment dissociation spectra and collisional quenching cross section data for molecules of importance as reservoirs of potential energy which can be transferred to other lasing species.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0002, LASER SPECTROSCOPY AND COLLISION STUDIES OF MOLECULAR IONS
W.H. WING, Univ. of Arizona, School of Liberal Arts, *Tucson, Arizona* 85721 (10233-AC6)

This proposal concerns high-precision spectroscopy of vibration-rotational frequencies of molecular ions, employing a novel ion beam-infrared laser resonance method which has recently produced the first observed infrared spectrum of the hydrogen molecular ion, Nature's simplest molecule. This result has opened the possibility of a wide range of molecular ion studies producing highly accurate and detailed measurements both of internal structure and of collision cross sections of molecular ions in individual vibrational states. Such spectroscopic data are at present nonexistent for most molecular ions except from estimates or theoretical predictions. Similarly most measured cross sections are averages over internal-state distributions.

If successful, the program would establish energy levels of molecular ions to at least the precision with which levels of neutral molecules are now known. Thus the results will be of great importance to quantum chemistry, molecular theory, astrophysics, and the description of high-temperature gaseous and plasma processes.

SUPPORTED BY American Chemical Society

8.0003, LABORATORY STUDIES OF SPACE PLASMA-RELATED PHENOMENA
R.L. STENZEL, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (ATM77-18736)

This grant will start a new effort at merging laboratory plasma physics and space science. The Principal Investigators will perform a second generation of laboratory experiments in large plasma devices in a parameter regime scaled to the earth's magnetosphere. The goal is to test experimentally various theories of important space plasma physics problems. By establishing an interdisciplinary collaboration between laboratory plasma physics, theoretical plasma physics, computer simulations, space science and astrophysics, there is every expectation of significant progress.

Earlier attempts to perform laboratory experiments on space plasma physics problems were of limited success due to a lack of a suitable large laboratory plasma. The first-generation experiments suffered from undesirable boundary effects, which do not exist in space.

With this grant, second generation experiments will be performed in the large plasma device at UCLA. Specific objectives are to understand magnetic field reconnection and nonlinear Whistler wave phenomena.

SUPPORTED BY U.S. National Science Foundation, Div. of Atmospheric Sciences

8.0004, OPTICAL PROPERTIES OF SMALL BAND GAP SEMICONDUCTORS SUBJECT TO LASER EXCITATION
T.C. MCGILL, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DF047320; AF-AFOSR-3216-77)

AF function - aerospace communications, surveillance and detection systems require electrooptical devices which exploit the special properties and interactions of infrared radiation with solid-state materials. Opportunity - the far-infrared region of the electromagnetic spectrum has been virtually unexplored for airborne and satellite applications. Sophisticated electrooptical techniques in narrow band gap compound semiconductors offer promise for electrooptical microcircuitry in the spectral range 10 to 100 micrometers. Objective - this study investigates the effect of carriers generated by laser illumination on the optical properties of small band gap semiconductors of interest for the construction of infrared sources and detectors, and the behavior of a nonequilibrium distribution of electrons and holes produced in a small band gap semiconductor like Hg1-xCdxTe. Objectives are to determine: (1) the kinds of quantum states formed by these carriers under different conditions of carrier density and temperature, (2) the energy of these states, (3) the lifetimes of these states, and (4) the effect carriers in different quantum states have on the optical and electrical properties of the material. How work contributes - infrared detectors and tunable infrared sources of coherent radiation require solid-state materials with narrow band gaps, controlled carrier concentrations and doping to provide optimal performance characteristics. Such investigations should lead to the formulation of models and mechanisms of linear and nonlinear interactions of laser light with solids and the un-

derstanding of basic parameters that control the properties and behavior of narrow band gap semiconductors.

Experimentally, high-resolution measurements of photoluminescence, absorption and the modification of absorption by high-intensity laser excitation are being made. These measurements should provide information about states formed by photogenerated carriers under various experimental conditions. Binding energies for the states formed by the photogenerated carriers (excitons, bound excitons, electron-hole plasma) in HgCdTe are determined theoretically. Auger transition rates for bound excitons and the impurity cross section to capture a free exciton and form a bound exciton are computed.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0005, SUPERCONDUCTIVITY IN INTERMETALLIC MATERIALS

B.T. MATTHIAS, Univ. of California, Graduate School, *San Diego, California* 92037 (DF033380; F49620-77-C-0009)

AF function - high transition temperature superconducting materials are needed for application in airborne multimegawatt power generation and conditioning systems. Opportunity - research specifically directed toward the synthesis and characterization of high transition temperature metallic compounds can provide a greater margin of design efficiency and operational reliability than presently available superconductors. Objective - the goal of this research is to discover the occurrence of superconductivity in new ternary metallic systems. Emphasis is placed on light elements such as boron, carbon, nitrogen and sulfur. Crystal symmetry and electron ratio are being studied to enhance the superconducting critical transition temperature in these synthesized materials. The role of structural instabilities in increasing or decreasing the transition temperature is being investigated. The ability to predict the existence and transition temperature of superconductors by means of normal state properties is being sought. How work contributes - the performance of high field magnets and solenoids, electric motor windings, superconducting rotors in power generators, transformers and induction energy storage systems could be significantly improved if the upper critical field, the current-carrying capacity and the critical transition temperature of the superconducting material could be enhanced.

The techniques of metallurgy and physics are utilized to: synthesize, measure, and analyze new multicomponent superconductors, synthesize and measure new metastable superconductors, by somehow circumventing their instabilities, perform electric and magnetic measurements on superconducting materials at normal and high pressure, and perform low-temperature X-ray diffraction measurements on superconductors.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0006, CRITICALLY EVALUATED DATA ON OPTICAL AND TRANSPORT PROPERTIES OF SOLIDS

H.H. LI, Purdue University, School of Science, *Lafayette, Indiana* 47907 (DF044030; F44620-76-C-0105)

AF function - weapons, defense. Deficiency - lack of readily available standard reference data on basic solid materials (metals, alloys, refractory compounds) hampers materials development and evaluation for EM radiation resistance. Objective - the goal of this work will be tables of evaluated optical property and electrical resistivity data at high temperatures on selected solid materials of potential importance in laser window and laser-hardened materials technologies. How work contributes - the products of this work will be widely used by design engineers and as input data for a variety of computer programs.

Properties to be first evaluated will be index of infraction and absorption index as functions of wavelength, and the temperature and pressure dependence of both. These will be done for selected families of elements and compounds which may be important in Air Force laser-hardened materials technology. Electrical resistivity and its variation with temperature will be simultaneously reviewed. These results will be accomplished by collecting and organizing all available pertinent experimental data, critically evaluating it, and recommending most probable values. The work of evaluation, and of interpolation and extrapolation, will be aided by the development of improved theoretical or semi-empirical inter-property relationships.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0007, THEORY OF INTERACTIONS OF MESONS AND NUCLEONS WITH NUCLEI

M.M. STERNHEIM, Univ. of Massachusetts, School of Arts & Sciences, *Amherst, Massachusetts* 01002 (PHY77-07592)

Theoretical research in intermediate-energy nuclear physics initiated under NSF Grant PHY74-11793 AO2 will be continued. Among the topics to be investigated are: A. Optical models for pion-nucleus interactions. B. Charge exchange in incoherent nuclear processes. C. Nucleon-nucleon and nucleon-antinucleon forces.

SUPPORTED BY U.S. National Science Foundation, Div. of Physics

8.0008, LASER-PRODUCED PLASMAS AND RADIATION SOURCES

B. LAX, Mass. Inst. of Technology, School of Science, *Cambridge, Massachusetts* 02139 (DF042150; F44620-76-C-0002)

AF function - operation of high-altitudes vehicles in a post-nuclear explosion environment, development of electromagnetic weapons, space and ionospheric communications as well as countermeasures demand the fundamental understanding of interactions between laser beams and plasmas in the presence of strong magnetic fields. Deficiency - the aforementioned information for the design of advanced equipment is not available today. Its acquisition may be realized by a well-planned theoretical and experimental research program. Objective - this program will study the interaction of lasers with plasma and the resulting X-rays, specifically the collision of laser-driven ionization waves and the effect of a strong magnetic field upon the backscattering of CO2 laser radiation from a laser-produced plasma. Contribution - this work is a part of a comprehensive program of plasma research for the development of an X-ray radiation source for simulation of nuclear weapon effects, the development of advanced electromagnetic weapons (laser and particle beams), the development of space and ionospheric communications, and the development of countermeasures.

This project will perform the following research: (1) it will develop a new generation of soft X-ray diagnostics to be used in the study of spatial and temporary evaluation of plasmas created by laser irradiation of gaseous and solid targets. They will build an X-ray 'pinhole' camera which may be operated in the longitudinal 'slit' mode and a soft X-ray spectrometer which can resolve X-ray lines from H, He and Li-like states of highly stripped elements, e.g., oxygen and aluminum, (b) it will study head-on collisions between laser-driven ionization waves in gaseous targets, (c) it will study the stimulated Brillouin backscatter from CO2 laser-induced plasmas in which a strong magnetic field is imposed transversely to the focal axis of the incident laser radiation. In this task they are in close contact and cooperation with Profs. Ong and Duderstadt of Michigan (grant AFOSR 76-2904) who are doing theoretical work in this area.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0009, LIFETIMES AND QUENCHING RATES FOR THE TRIPLET PI STATES OF INTERHALOGEN MOLECULES

J. WRIGHT, Univ. of New Hampshire, School of Technology, *Durham, New Hampshire* 03824 (DF047470; AF-AFOSR-3232-77)

AF function - reconnaissance, communication, weaponry. Deficiency - there is a lack of a high-power, efficient chemically pumped, electronic transition laser which is a projected requirement for future Air Force applications. Objective - use laser-induced time-resolved spectroscopy to measure the decay rate and quenching rates for the triplet-pi states of several interhalogen molecules which are attractive candidates for chemical lasers. How work contributes - a requirement for a chemically-pumped electronic-transition laser is that the decay rate of the excited-

state and quenching rates be less than the chemical reaction rate. This research intends to measure these rates for interhalogen molecules which have been identified as candidate electronic transition laser molecules.

A tunable dye laser will be used to excite the triplet pi electronic states of certain interhalogen molecules. Time-resolved fluorescence spectroscopy will be used to infer the excited-state lifetimes and quenching rates in the presence of other molecules.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0010, DIATOMIC MOLECULE PROPERTIES IN THE INTERMEDIATE ENERGY TO DISSOCIATION LIMIT RANGE

C.L. BECKEL, Univ. of New Mexico, School of Arts & Sciences, *Albuquerque, New Mexico* 87106 (DF046320; AF-AFOSR-3132-77)

AF function - this research contributes to research objective 6.1, nuclear weapons effects. Deficiency - weapons effects computer codes need information on the energy levels of diatomic molecules. Objective - this program is directed toward achieving better understanding of and more useful procedures for treating diatomic molecule bound states in the intermediate-to-high energy range. Contribution - this research will permit more reliable description of diatomic molecule properties in high-energy, high-temperature environments.

Expressions are being developed that relate vibration-rotation eigenenergy e-sub-v, j to vibrational quantum number v. Eigenvalues are being found for a set of model potentials and a corresponding set of actual potentials that correlate with a variety of separated atom states. Reduced mass is being varied to vary eigenvalue density as an aid in determining e-sub-v, j versus v functional forms. Possible causes for failure of the RKR method near dissociation are being evaluated and improvements are being devised to make RKR useful at high v.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0011, DISPERSION FORCES OF SOLIDS UNDER STRESS 15385-P

L.C. BIEDENHARN, Duke University, School of Arts & Sciences, *Durham, North Carolina* 27706 (DA0F9043; DAAG29 77 G0184)

To arrive at a realistic potential energy function for adatom-solid surface adsorption that will be valid when the solid is under high external stresses. Relevance - the calculations are directly relevant to stress-corrosion and wear problems of the Army.

To use diagrammatic field theoretic techniques to obtain the dielectric response function as well as to use a phenomenological approach to include changes in the polarizabilities of the solid when the solid is stressed.

SUPPORTED BY U.S. Dept. of Defense, Development & Readiness Command, Army Research Office

8.0012, SEMICONDUCTOR PROPERTIES

C.W. LITTON, U.S. Air Force, Avionics Laboratory, *Dayton, Ohio* 45433 (DF104050)

The objective of this effort is to completely characterize ahe electronic defect structure of III-V semiconductors, including selected ternary and quarternary compounds. Emphasis will be given to characterization of residual impurities, native defects, impurity dopants and concentration profiles in high-purity epitaxial layers and melt-grown substrate crystals. The homogeneity of impurities and lattice imperfections, as well as the electronic defect structure at surfaces and interfaces of these materials, will also be investigated. A major part of the effort will be devoted to impurity and defect characterization in GaAs and InP materials required for high-frequency microwave and opto-electronic devices, such as diode power sources, high power FETs, digital processing systems, laser diodes, optical light guides and infrared detectors.

Optical, magnetooptical and other spectroscopic techniques will be employed, in conjunction with carefully controlled crystal growth and doping, to characterize residual and doped concentrations of both shallow and deep donor and acceptor impurities, stoichiometric defects and the surface properties of GaAs and other III-V materials. Optical and magnetooptical spectroscopy, such as high-resolution photoluminescence, is one of the most powerful and sensitive methods available for characterization of the electronic defect state and is relatively cheap, nondestructive and easy to apply. Spectral measurements surface states and their effects on electronic defect structure will be assessed. Deep impurity centers and defects will be characterized by means of near-infrared spectroscopy, while far-infrared local mode spectroscopy will be used to resolve and identify isoelectronic as well as donor and acceptor impurities in both n and p-type layers and substrates. Spectral results will be correlated with electrical properties and with performance of microwave device structures.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Avionics Lab.

8.0013, INVESTIGATIONS IN X-RADIATION STIMULATION

K. DASGUPTA, Texas Tech University, School of Arts & Sciences, *Lubbock, Texas* 79409 (DF035070; AF-AFOSR-3098-76)

AF function - nondestructive testing of structural members of aerospace vehicles could benefit greatly from the development of an X-ray laser for use in three-dimensional holography. Deficiency - attempts to develop an X-ray laser by standard population inversion techniques have been unsuccessful primarily because of short life times of excited states. Objective - the objective of this research is to investigate the nature of nearly nondivergent beam of X-rays (hot spots) which apparently are generated by hitherto undiscovered processes and to use this radiation to make three-dimensional holograms of opaque materials. How work contributes - an understanding of the nature of these hot spots could lead to or contribute to the development of X-ray lasers and three-dimensional holography could lead to important nondestructive testing techniques for structural materials.

The nearly nondivergent beam of X-rays will be studied to determine their penetration properties in various materials, role of stimulated emission, and the degree of coherence and polarization. Three-dimensional holograms will be made in collaboration with Prof. N. George of University of Rochester.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

8.0014, HELIUM LIQUEFIER

O.E. VILCHES, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (DMR77-11393)

A helium liquefier will be purchased to provide liquid helium for the scientific program at the University of Washington. The research will be carried out primarily in the Departments of Physics, Chemistry, Biochemistry, and Astronomy.

Typical research areas include: 1) Studies of the cosmic background radiation at 3 Kelvin, 2) Studies of photochemical reactions, 3) Studies in monolayer physics, 4) Studies in solid-state physics, and 5) Spectroscopic studies.

SUPPORTED BY U.S. National Science Foundation, Div. of Materials Research

SOCIAL SCIENCES

Includes Social Sciences (general); Administration and Management; Documentation and Information Science; Economics and Cost Analysis; Law and Political Science; and Urban Technology and Transportation.

9.0001, SATELLITE TELECONFERENCING

UNKNOWN, Univ. City Science Center, *Philadelphia, Pennsylvania* 19104 (1722-720108)

SCOPE: Project regarded as first phase of research on teleconferencing as a means of involving U.S. and a developing country or countries, to review the conceptual and practical problems involved in such an experiment, and to develop criteria and procedures for evaluating such an experiment.

SUPPORTED BY U.S. Dept. of State, Bureau of Intelligence & Research

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, A COSMOLOGICAL STUDY OF VERY FAINT GALAXIES
J.B. OKE, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (AST76-22111 A01)

The present survey program to find very distant clusters of galaxies is about 75 percent complete. The only fields not yet properly surveyed are those in the North Galactic Cap, which must be observed in the spring when observations are difficult because of the weather. Since the first paper on the Hubble relation was published, 38 galaxies in very faint clusters have been observed; many of these have red shifts greater than 0.40. A study of a carefully selected group of Abell clusters has been made to provide better statistics at the bright end of the Hubble diagram. A study of evolutionary effects in galaxies indicates that color changes are very small; changes do occur, however, in spectral features. Research will continue on stellar synthesis of galaxy spectra.

The major observational thrust will be to complete the survey in the next two years and to obtain red shifts and spectral characteristics for all the clusters found in the survey. Emphasis will be placed on SIT spectrograph observations because they can be made quickly and provide the resolution needed to study spectral features for evolutionary effects with distance. Theoretical research will be done on such problems as the swallowing up of small galaxies by large ones and the whole subject of the 'hidden mass' in galaxies and clusters.

This action provides additional funding and extends the duration of the grant AST 76-22111.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

10.0002, THEORETICAL LYMAN-ALPHA AND BALMER-ALPHA SPECTRA FOR PUBLISHED CHROMOSPHERIC FLARE MODELS
R. CANFIELD, Univ. of California, Graduate School, *San Diego, California* 92037 (DF044440; AF-AFOSR-3071-76)

AF function - transient events on the sun are ultimately responsible for most if not all of the ionospheric disturbances on the earth. The greatest perpetrators of these disturbances are solar flares. Air Force communications are greatly affected by solar flares and there is an immediate need to understand them and be able to predict their occurrence. Deficiency - in spite of their being the subject of intensive research, flares are little understood. The initiation mechanism, the energy source and the energy transfer mechanism remain unknown. Objective - this particular study will concentrate on the problem of energy transfer within a flare. Contribution - knowledge of the method and time scales involved in the transfer of energy within a flare will eventually lead to a test for the validity of flare models.

In the first phase Dr. Canfield will develop a suitable computer code to treat the non-LTE, partial redistribution radiative transfer problem for hydrogen, particularly Lyman-alpha. In the second phase, Dr. Canfield will compute Lyman-alpha and Balmer-alpha line profiles for recently-published solar flare models based on various assumptions concerning the mechanism responsible for the chromospheric flare. This work serves to show whether or not the available models are based on a realistic radiative energy balance. If so, one can determine what quantitative characteristics the flare energy-production mechanism must have by comparison of observed and computed Balmer-alpha and Lyman-alpha profiles.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Office of Scientific Research

10.0003, SOLAR CONVECTION AND OBSERVED ATMOSPHERIC MOTION
J. TOOMRE, Univ. of Colorado, School of Arts & Sciences, *Boulder, Colorado* 80302 (DF248990; F19628-77-C-0104)

AF function - communications, surveillance, detection, tracking. Deficiency - inadequate solar disturbance predictions. Objective -determine the mechanism responsible for the generation of solar surface magnetic fields and develop an understanding of the long-term behavior of these fields. How research contributes - a complete model of solar magnetic field generation including dynamo processes will enable long-term predictions of solar activity to be made.

Determine observationally the parameters of observed solar surface motions. From these the properties of the underlying connection and the detailed process of dynamo generation of solar magnetic fields can be deduced. By extending these studies into the chromosphere by using space observations in the UV the mechanisms of magnetic field concentration and subsequent release in flares can be investigated.

SUPPORTED BY U.S. Dept. of Defense, Air Force, Geophysics Lab.

10.0004, COMPILATION OF REFERENCE STAR CATALOGS
E.S. JACKSON, U.S. Navy, Observatory, *Washington, District of Columbia* 20390 (DN546021)

Compile catalogs of accurate positions of 20,000 reference stars in each hemisphere of sky in support of Naval Observatory mission in time determination and navigation.

(1) Reduce all reference star observations made with Naval Observatory seven-inch transit circle telescope at El Leoncito, Argentina, to a system of reference defined by fundamental stars; (2) coordinate observations of reference stars being made at 20 cooperating observatories; (3) collect all results of observations of reference stars, and analyze and compile catalogs of final positions.

SUPPORTED BY U.S. Dept. of Defense, Navy, Naval Observatory

10.0005, HIGH-RESOLUTION STUDIES OF THE SOLAR CHROMOSPHERE FROM SPACE
J.M. PASACHOFF, Williams College, Graduate School, *Williamstown, Massachusetts* 01267

SUPPORTED BY Research Corp.

10.0006, THEORETICAL GALACTIC DYNAMICS AND HIGH-ENERGY ASTROPHYSICS
J.P. OSTRIKER, Princeton University, Graduate School, *Princeton, New Jersey* 08540 (AST76-20255 A01)

Theoretical research will be directed toward a number of astrophysical topics. Answers will be sought to questions such as: In what form is the dark mass which we know exists in the outer parts of galaxies? Is there any simple way that the Hubble sequence of galaxy forms can be understood as a variation of a single parameter defining the initial state of a protogalaxy? Is either the size or mass of galaxies understandable from physical principles or are these broadly distributed parameters having no preferred values? Could they be large black holes accreting diffuse gas? Can the energy (rather than momentum) absorbed by accreting gas be so large as to inhibit the accretion giving a limit like the Eddington limit? Will turbulence in the accretion disc produce hot coronae and winds, thus invalidating the assumptions on which the standard models for X-ray sources are based? Do embedded pulsars make a significant contribution to supernova dynamics? Can the collection of galactic supernova effectively sweep out almost all of the intercloud medium producing the hot gas seen by the Copernicus satellite? The questions are a sample of those that will be considered in this research.

SUPPORTED BY U.S. National Science Foundation, Div. of Astronomical Sciences

GENERAL

11.0001, EFFECT OF MCCOOK FIELD ON AMERICAN AVIATION

D.S. LOPEZ, Smithsonian Institution, *Washington, District of Columbia* 20560

This research will result in a monograph or, more probably, a book, covering the effect of the research carried out by the U. S. Army at McCook Field, Ohio from 1917 to 1927 on the development of American aviation.

Some of the major innovations and developments as well as the history of some of the personnel will be traced through the end of WW II.

Publication is expected during FY 78.

SUPPORTED BY Smithsonian Institution, National Air & Space Museum

American Institute of
Aeronautics and Astronautics

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The spirit and joy of creativity as exemplified in aircraft design is the story of this film. America's Wings looks at everything that has happened since Kitty Hawk and the "somebodies" who made it happen. (28.5 minutes, 16 mm color)

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For information on obtaining these films, contact:
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Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N78-21044*# General Electric Co., Cincinnati, Ohio.
WIND TUNNEL PERFORMANCE TESTS OF COANNULAR PLUG NOZZLES Final Report
Paul S. Staid Washington NASA Apr. 1978 116 p refs
(Contract NAS3-19777)
(NASA-CR-2990; Rept-77AEG596) Avail: NTIS HC A06/MF A01 CSCL 02A

Wind tunnel performance test results and data analyses are presented for dual-flow plug nozzles applicable to supersonic cruise aircraft during takeoff and low-speed flight operation. Outer exhaust stream pressure ratios from 1.5 to 3.5 were tested; inner exhaust stream conditions were varied from very low, or bleed flow rates, up to a pressure ratio of 3.5. Mach numbers tested ranged from zero to 0.45. Measured thrust coefficients for the eight model configurations, operating at an external Mach number of 0.36 and an outer flow pressure ratio of 2.5, varied from 0.95 to 0.974 for high inner flow rates. At low inner flow, the performance ranged from 0.88 to 0.97 for the same operating conditions. The primary design variables influencing the performance levels were the annular height of the inner and outer nozzle throats (denoted by radius ratio - the ratio of inner-to-outer flowpath diameter at the nozzle throat), the plug geometry, and the inner stream flow rate. Author

N78-21045# Naval Postgraduate School, Monterey, Calif.
A LIFE CYCLE COST STUDY OF CONTRACTOR VERSUS ORGANIC SUPPORT OF AIRCRAFT PROGRAMS M.S. Thesis
John Joseph McMenamin, Jr. Dec. 1977 54 p refs
(AD-A049438) Avail: NTIS HC A04/MF A01 CSCL 05/3

This thesis conducts a cost comparison between contractor and organic support for the CH-53 Aircraft in two major operating cost areas, training and aircraft overhaul. A life cycle cost approach is used and cost differentials are found for the twenty year life expectancy of the CH-53 system. The intent of the study was not to criticize or change the existing system, but rather to provide cost data and planning insight for future aircraft systems. Author (GRA)

N78-21046# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD HIGHLIGHTS
Mar. 1978 34 p
(AGARD-Highlights-78/1) Avail: NTIS HC A03/MF A01

Activities of the flight mechanics panel are reported. Topics covered include: flight dynamics research, flight simulation and testing, systems integration, and optimization. Technological developments for the solution of operational problems are also discussed. Denmark's contribution to NATO efforts are summarized. A.R.H.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N78-21047*# McDonnell-Douglas Corp., Long Beach, Calif.
A THREE-DIMENSIONAL POTENTIAL-FLOW PROGRAM WITH A GEOMETRY PACKAGE FOR INPUT DATA GENERATION Technical Report, 7 May 1976 - 22 Aug. 1977
N. Douglas Halsey Mar. 1978 67 p refs
(Contract NAS1-14402)
(NASA-CR-145311; MDC-J7733) Avail: NTIS HC A04/MF A01 CSCL 01A

Information needed to run a computer program for the calculation of the potential flow about arbitrary three dimensional lifting configurations is presented. The program contains a geometry package which greatly reduces the task of preparing the input data. Starting from a very sparse set of coordinate data, the program automatically augments and redistributes the coordinates, calculates curves of intersection between components, and redistributes coordinates in the regions adjacent to the intersection curves in a suitable manner for use in the potential flow calculations. A brief summary of the program capabilities and options is given, as well as detailed instructions for the data input, a suggested structure for the program overlay, and the output for two test cases. Author

N78-21048*# National Aeronautics and Space Administration, Washington, D. C.
AIRFOIL PROFILE IN A NONUNIFORM FLOW
Jan Polasek Mar. 1978 53 p refs Transl. into ENGLISH from Rev. Roum. Sci. Tech., Ser. Mecan. Appl. (Romania), v. 9, no. 3, 1964 p 617-666 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Government Research Inst. for Heat Technology, Prague (Czechoslovakia)
(Contract NASw-2791)
(NASA-TM-75272) Avail: NTIS HC A04/MF A01 CSCL 01A

A theory of airfoil section past two dimensional nonuniform flow is developed. The theory is based on representation of airfoil section by vortex and source distributions and it can be used for calculation of aircraft wings in homogeneous and inhomogeneous flow, as well as for calculation of straight and radial blade and vane-cascades. Author

N78-21049*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
SUBSONIC LONGITUDINAL AND LATERAL-DIRECTIONAL STATIC AERODYNAMIC CHARACTERISTICS FOR A CLOSE-COUPLED WING-CANARD MODEL IN BOTH SWEPT BACK AND SWEPT FORWARD CONFIGURATIONS
Jarrett K. Huffman and Charles H. Fox, Jr. Feb. 1978 60 p refs
(NASA-TM-74092) Avail: NTIS HC A04/MF A01 CSCL 01A

A general research fighter model was tested in the Langley 7 by 10-foot high speed tunnel at a Mach number of 0.3. The close-coupled wing-canard combination was tested with both lifting surfaces in a 60 deg swept back configuration and in a 32 deg swept forward configuration. The angle-of-attack range was from approximately -4 deg to 48 deg at sideslip angles of zero deg, -5 deg. The data is presented without analysis in order to expedite publication. Author

N78-21050*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A VECTORIZATION OF THE JAMESON-CAUGHEY NYU TRANSONIC SWEPT-WING COMPUTER PROGRAM FLO-22-V1 FOR THE STAR-100 COMPUTER
Robert E. Smith, Joan I. Pitts, and Jules J. Lambiotte Mar. 1978 32 p refs
(NASA-TM-78665) Avail: NTIS HC A03/MF A01 CSCL 01A

The computer program FLO-22 for analyzing inviscid transonic flow past 3-D swept-wing configurations was modified to use vector operations and run on the STAR-100 computer. The vectorized version described herein was called FLO-22-V1. Vector operations were incorporated into Successive Line Over-Relaxation in the transformed horizontal direction. Vector relational operations and control vectors were used to implement upwind differencing at supersonic points. A high speed of computation and extended grid domain were characteristics of FLO-22-V1. The new program was not the optimal vectorization of Successive Line Over-Relaxation applied to transonic flow; however, it proved that vector operations can readily be implemented to increase the computation rate of the algorithm. Author

N78-21051*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF LEADING-EDGE CONTOUR AND VERTICAL-TAIL CONFIGURATION ON THE LOW-SPEED STABILITY CHARACTERISTICS OF A SUPERSONIC TRANSPORT MODEL HAVING A HIGHLY-SWEPT ARROW WING
Vernard E. Lockwood Mar. 1978 53 p refs
(NASA-TM-78683) Avail: NTIS HC A04/MF A01 CSCL 01A

A low-speed investigation was made on a highly-swept arrow-wing model to determine the effect of wing leading-edge contour and vertical-tail configuration on the aerodynamic characteristics in pitch and sideslip. The investigation was made with the trailing-edge flaps deflected over a range of angles of attack from 8 deg to 32 deg. The tests were made at a Mach number of 0.13, which corresponds to a Reynolds number of about 3,000,000 based on the wing reference chord. Author

N78-21052*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF AERODYNAMIC DATA MEASURED IN AIR AND FREON-12 WIND-TUNNEL TEST MEDIUMS
William H. Weller (Army Res. and Technol. Labs.) Mar. 1978 56 p refs
(NASA-TM-78671) Avail: NTIS HC A04/MF A01 CSCL 01A

An experimental investigation was carried out to measure two dimensional static aerodynamic characteristics of a 65 sub l-213 airfoil in air and Freon-12 (dichlorodifluoromethane) test mediums at corresponding test conditions. The purpose of the tests was to compare measurements in the two test mediums and to evaluate reported methods of converting Freon-12 data to equivalent air values. The test article was a two dimensional wing instrumented to measure chordwise surface pressure distributions. The parameters considered were Mach numbers from 0.6 to 1.0, angles of attack of zero deg and 1 deg, and Reynolds numbers based on model chord from 2,000,000 to 21,000,000. The agreement between data measured in the two test mediums is further improved by application of the transonic or area ratio similarity laws. Where flow conditions are characterized by surface shocks or stall, the effects of flow separation may not be identically reflected in the Freon-12 data, even when converted in accordance with existing similarity laws. Author

N78-21053*# Vought Corp., Hampton, Va. Technical Center.
LOW-SPEED AERODYNAMIC CHARACTERISTICS FROM WIND-TUNNEL TESTS OF A LARGE-SCALE ADVANCED ARROW-WING SUPERSONIC-CRUISE TRANSPORT CONCEPT
Paul M. Smith Apr. 1978 102 p refs
(Contract NAS1-13500)
(NASA-CR-145280) Avail: NTIS HC A06/MF A01 CSCL 01A

Tests have been conducted to extend the existing low speed aerodynamic data base of advanced supersonic-cruise arrow wing configurations. Principle configuration variables included wing leading-edge flap deflection, wing trailing-edge flap deflection, horizontal tail effectiveness, and fuselage forebody strakes. A limited investigation was also conducted to determine the low speed aerodynamic effects due to slotted trailing-edge flaps. Results of this investigation demonstrate that deflecting the wing leading-edge flaps downward to suppress the wing apex vortices provides improved static longitudinal stability; however, it also results in significantly reduced static directional stability. The use of a selected fuselage forebody strakes is found to be effective in increasing the level of positive static directional stability. Drooping the fuselage nose, which is required for low-speed pilot vision, significantly improves the lateral-directional trim characteristics. Author

N78-21054# Aeronautical Research Labs., Melbourne (Australia).
A BRIEF EXAMINATION OF THE FLOW EXTERNAL TO AN F-111 INTAKE AT MACH 1.6
Murdoch Culley Jul. 1975 39 p refs
(ARL/ME-Note-357) Avail: NTIS HC A03/MF A01

A one-thirtieth scale wind tunnel model of the forward fuselage and intakes of an F-111 aircraft was used to investigate qualitatively, at Mach 1.6, the interference flows which occur in the vicinity of the intakes. The intake configuration employed was based on the SWIP design, pre-cursor to the Triple Plow I configuration fitted to the Australian F-111c aircraft. The intake mass flow was varied between supercritical and subcritical, with the model attitude varying between 0 and 9 degrees incidence and plus or minus 4.5 degrees of yaw. The test Reynolds number, based on the model's intake diameter, was 80,000. The fuselage boundary layer was observed to be distorted by cross flows established through model incidence and yaw, causing it to thicken locally upstream of the intakes. The fuselage boundary-layer splitter plate, fitted to prevent the fuselage boundary-layer interacting with the intake shock system as well as to prevent its ingestion by the intakes, was unable to digest the model boundary-layer. This caused a severe three dimensional separation upstream of the splitter plate, which interfered with the wing flow because of a shock generated at the fuselage separation. Author

N78-21055*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NUMERICAL STUDY OF TRANSONIC FLOW OVER OSCILLATING AIRFOILS USING THE FULL POTENTIAL EQUATION
Koji Isogai Apr. 1978 41 p refs
(NASA-TP-1120; L-11984) Avail: NTIS HC A03/MF A01 CSCL 01A

The behavior of unsteady aerodynamic loadings on airfoils oscillating in transonic flow has been investigated numerically with particular attention given to supercritical airfoil sections. A previously developed finite difference method, which is based on the full potential equation and which uses a quasi-conservative scheme for proper capture of a shock wave motion, was employed for the present study. The unsteady aerodynamic pressure and load distributions on several different airfoil sections are presented with particular emphasis on the effects of free-stream Mach number, reduced frequency, and mean angle of attack. These parameters are demonstrated to have a significant effect on the behavior of the unsteady aerodynamic loadings. Comparisons of the present calculations with the exact inviscid solution and with the experimental results are also presented. Author

N78-21056*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLOW FIELD VISUALIZATION ABOUT EXTERNAL AXIAL CORNERS
Noel A. Talcott, Jr. Mar. 1978 24 p refs
(NASA-TM-78682) Avail: NTIS HC A02/MF A01 CSCL 01A

An experimental investigation was conducted to visualize

the flow field about external axial corners. The investigation was initiated to provide answers to questions about the inviscid flow pattern for continuing numerical investigations. Symmetrical and asymmetrical corner models were tested at a Reynolds number per meter of 60,700,000. Oil-flow and vapor-screen photographs were taken for both models at angle of attack and yaw. The paper presents the results of the investigation in the form of oil-flow photographs and the surrounding shock wave location obtained from the vapor screens. Author

N78-21057*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPILATION OF WIND TUNNEL COEFFICIENTS FOR PARABOLIC REFLECTORS
R. Levy and D. Kurtz 15 Apr. 1978 88 p ref
(Contract NAS7-100)
(NASA-CR-156161; JPL-Pub-78-16) Avail: NTIS HC A05/MF A01 CSCL 01A

Wind tunnel data to predict loading on antenna structures are tabulated. Author

N78-21058*# Pratt and Whitney Aircraft Group, East Hartford, Conn.
MEAN VELOCITY, TURBULENCE INTENSITY AND TURBULENCE CONVECTION VELOCITY MEASUREMENTS FOR A CONVERGENT NOZZLE IN A FREE JET WIND TUNNEL Final Report
C. J. McColgan and R. S. Larson Apr. 1978 31 p refs
(Contract NAS3-17866)
(NASA-CR-2949; PWA-5506) Avail: NTIS HC A03/MF A01 CSCL 01A

The effect of light on the mean flow and turbulence properties of a 0.056 m circular jet were determined in a free jet wind tunnel. The nozzle exit velocity was 122 m/sec, and the wind tunnel velocity was set at 0, 12, 37, and 61 m/sec. Measurements of flow properties including mean velocity, turbulence intensity and spectra, and eddy convection velocity were carried out using two linearized hot wire anemometers. Normalization factors were determined for the mean velocity and turbulence convection velocity. Author

N78-21059*# Nevada Univ., Las Vegas.
UNSTEADY TWO DIMENSIONAL AIRLOADS ACTING ON OSCILLATING THIN AIRFOILS IN SUBSONIC VENTILATED WIND TUNNELS
Joseph Fromme and Michael Golberg May 1978 139 p refs
(Grant NsG-2140)
(NASA-CR-2967) Avail: NTIS HC A07/MF A01 CSCL 01A

The numerical calculation of unsteady two dimensional airloads which act upon thin airfoils in subsonic ventilated wind tunnels was studied. Neglecting certain quadrature errors, Bland's collocation method is rigorously proved to converge to the mathematically exact solution of Bland's integral equation, and a three way equivalence was established between collocation, Galerkin's method and least squares whenever the collocation points are chosen to be the nodes of the quadrature rule used for Galerkin's method. A computer program displayed convergence with respect to the number of pressure basis functions employed, and agreement with known special cases was demonstrated. Results are obtained for the combined effects of wind tunnel wall ventilation and wind tunnel depth to airfoil chord ratio, and for acoustic resonance between the airfoil and wind tunnel walls. A boundary condition is proposed for permeable walls through which mass flow rate is proportional to pressure jump. Author

N78-21060# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
EFFECT OF TURBULENT JET MIXING ON THE STATIC LIFT PERFORMANCE OF A POWER AUGMENTED RAM WING
William J. H. Smithey, Basil S. Papadales, Jr., and Harvey R. Chaplin Sep. 1977 19 p refs
(AD-A049620; DTNSRDC/ASED-389) Avail: NTIS HC A01/MF A01 CSCL 20/4

Calculation procedures are developed using axisymmetric and two dimensional turbulent jet theory for predicting the static lift performance of a two dimensional power augmented ram wing. The resulting lift prediction is found to be in good agreement with experimental data. Author (GRA)

N78-21061# Naval Postgraduate School, Monterey, Calif.
UNSTEADY, SURFACE PRESSURE AND NEAR-WAVE HOTWIRE MEASUREMENTS OF A CIRCULATION CONTROL AIRFOIL M.S. Thesis
Karl Aurel Kail, IV Sep. 1977 142 p refs
(AD-A050025) Avail: NTIS HC A07/MF A01 CSCL 20/4

The large lift coefficient changes attainable with Circulation Control Airfoils through small changes in boundary layer blowing suggest rotary wing cyclic control can be obtained through modulation of the blowing. Static pressure distributions were obtained to assess the unsteady behavior of a Circulation Control Rotor in a two-dimensional flow. A constant-radius hotwire wake traversing mechanism was constructed to augment the pressure data and to study the flow phenomena occurring in the region of Coanda jet separation. Through correlation of turbulence intensity data with pressure data, it was discovered that the point of Coanda jet separation could be located using the hotwire. The objective of these tests was accordingly expanded to include correlation of the location of separation with flow parameter variation. GRA

N78-21062# Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.
TRANSONIC WIND TUNNEL TESTS ON TWO-DIMENSIONAL AEROFOIL SECTIONS. DETERMINATION OF PRESSURE DISTRIBUTION AND DRAG FOR AN AEROFOIL WITH A MODIFIED NACA 65 SUB2-215 SECTION IN FFA WIND TUNNEL S5, PART 2 Interim Report
Goeran Ehn 1977 138 p refs
(Contracts F-INK-11-12-83343; F-INK-11-12-02871; F-INK-07-11966/02871; F-INK-07-21898; F-INK-82223-76-001-21-001)
(FFA-TN-AU-725) Avail: NTIS HC A07/MF A01

A two-dimensional airfoil model was investigated in FFA S5 0.25 sq m wind tunnel with a modified NACA 652-215 section. The modifications consisted of a decrease in the mean line chamber and a change of the thickness distribution over the rear part of the airfoil compared to the nominal section. The Reynolds number, based on the airfoil chord length, was in the range 2 million < or = Re < or = 2.3 million. Models with the same section were tested earlier at the National Aeronautical Establishment, Canada, at Reynolds numbers in the range 5 million < or = Re < or = 35 million. By means of tests with different locations of transition trips it was attempted to establish to what degree a simulation of these high Reynolds' number flow conditions could be achieved in wind tunnel S5. The test program included airfoil pressure distribution measurements and wake drag measurements in the Mach number range 0.6 < or = free stream Mach < or = 0.75 for angles of attack of alpha = 0 deg, 1.5 deg, 20 deg, and 40 deg. Sublimation tests and flow visualization tests were also performed.
Author (ESA)

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

N78-21063# National Transportation Safety Board, Washington, D. C.
SPECIAL STUDY: EMERGENCY LOCATOR TRANSMITTERS, AN OVERVIEW
26 Jan. 1978 33 p refs
(NTSB-AAS-78-1) Avail: NTIS HC A03/MF A01

A review of emergency locator transmitter (ELT) problems and efforts to solve these problems, and a survey of the current situation was conducted. Statistical data from the National Transportation Safety Board and the Air Force Rescue Coordination

Center for 1975 and 1976 is used in this study. Numerous discussions were held with a substantial segment of the ELT and search and rescue community, including those organizations specifically addressing the current ELT problems. Further, an intensive review of the ELT resource literature was completed, including technical papers, general articles, and communications from many of those organizations concerned with the ELT and search and rescue. Author

N78-21064# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT: SOUTHERN AIRWAYS INC., DC-9-31, N1335U, NEW HOPE, GEORGIA, APRIL 4, 1977
26 Jan. 1978 109 p
(NTSB-AAR-78-3) Avail: NTIS HC A06/MF A01

The National Transporation Safety Board determined that the probable cause of this accident was the total and unique loss of thrust from both engines while the aircraft was penetrating an area of severe thunderstorms. The loss of thrust was caused by the ingestion of massive amounts of water and hail which, in combination with thrust lever movement, induced severe stalling in and major damage to the engine compressors. Major contributing factors included the failure of the company's dispatching system to provide the flightcrew with up-to-date severe weather information pertaining to the aircraft's intended route of flight, the captain's reliance on airborne weather radar for penetration of thunderstorm areas, and limitations in the Federal Aviation Administration's air traffic control system which precluded the timely dissemination of real-time hazardous weather information to the flightcrew. Author

N78-21065# Futures Group, Gastonbury, Conn.
ALTERNATIVE FUTURE SCENARIOS FOR THE NATIONAL SYSTEM. VOLUME 1: EXECUTIVE SUMMARY Final Report, 30 Jun. 1976 - 30 Jan. 1977
E. Fein, C. Donahue, M. Oppenheimer, D. Goodrich, and H. Becker
Feb. 1977 52 p
(Contract DOT-FA6WA-3855)
(AD-A047084; Rept-276-72-05/01) Avail: NTIS HC A04/MF A01 CSCL 01/5

This study updated and expanded the five socioeconomic scenarios prepared for the FAA in the prior study similarly titled. These scenarios were revised to reflect changes in conditions since the original study and to incorporate new material that may better aid the FAA in policy analysis. Scenario sections on economics were greatly augmented to give substantive descriptions of the economic and financial processes, and a new sector on international conditions was added to each scenario. This volume contains an overview of study methods and results. Summaries are given of the five scenario narratives, and the chronology of key scenario events and the levels reached for major scenario variables are presented. Author (GRA)

N78-21066# Arinc Research Corp., Annapolis, Md.
INVESTIGATION TO SUPPORT PHASE 1 OF THE USAF MIDAIR PREVENTION SYSTEMS PROGRAM (MAPS) Final Report, Jun. - Oct. 1977
F. Crum, K. Haspert, S. Koualski, N. Sullivan, and J. Underwood
Oct. 1977 105 p refs
(Contract F09603-77-A-3104)
(AD-A049743; ASD-TR-77-76; Rept-1942-01-1-1676) Avail: NTIS HC A06/MF A01 CSCL 01/2

The objectives of the study presented in this report were to: further define USAF requirements and objectives in reducing midair collisions; establish organizational relationships and participation in midair prevention efforts; investigate possible alternative methods to reduce USAF midair collisions; and further define follow-on phases of the Midair Prevention Systems (MAPS) program that the USAF could undertake to reduce midair collision potential. This report provides background information and analysis on the midair collision experiences of the USAF from 1968 through June 1977 and the near midair collision experiences from 1975 through June 1977. The midair and near midair collision information is analyzed from many different aspects such as altitude, type flight plan, category of aircraft, mission activity, commands, and phase of flight. Midair collision programs were identified and actions that could be taken by the USAF to reduce midair collision potential are specified. This report also identifies various organizations that would be involved with the USAF midair problem and identifies their relationships in attempting to reduce the midair potential. The report also discusses the FAA and civilian viewpoints and activities as they relate to midair collision prevention. Author (GRA)

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications*.

N78-21067# Systems Research Labs., Inc., Dayton, Ohio.
AFAL TOWER CHARACTERIZATION FACILITY: 4 KM WEATHER INSTRUMENTATION TOWER Interim Report, 1 Apr. 1976 - 30 Mar. 1977
Wayne R. Chase Aug. 1977 78 p
(Contract F33615-76-C-1092)
(AD-A049525; SRL-6908; AFAL-TR-77-162) Avail: NTIS HC A05/MF A01 CSCL 04/2

A 130 ft high tower has been erected at the mid-point (4 km) of the AFAL Tower Characterization Facility to support weather instrumentation. The tower has an instrument package which can be lowered to ground level for repair or replacement of instruments, and then raised again to the top for operation. The instrument cart is designed so that other instrument packages can be easily substituted. The present instrument package includes the following: forward scatter meter, pyranometer, continuous-reading pluviometer, tipping bucket pluviometer, wind-speed and wind-direction sensors, temperature dewpoint set, and thermometer. The data collected from this weather instrumentation tower are being used to characterize the atmosphere on the performance of EO sensors. Author (GRA)

N78-21068# Radio Corp. of America, Van Nuys, Calif. Electromagnetic and Aviation Systems Div.
BEARING STUDY PROGRAM Final Report
Ernest Jellinek, Walter Kram, M. Levinsen, O. M. Woodward, and Bernard Case Apr. 1974 429 p refs
(Contract N62269-73-C-0906)
(AD-A049767; RCA-EASD-TP-2146) Avail: NTIS HC A19/MF A01 CSCL 01/2

A study was conducted to assess the feasibility and define the system accuracy and equipment required to add a bearing measurement subsystem to the SECANT Collision Avoidance System (CAS). The results indicate the feasibility of achieving the accuracy required to serve useful functions. Equipment configurations required for Proximity Warning Indicator and CAS applications were evolved and are presented in detail in this study. The approach utilizes a ring array antenna consisting of vertical monopoles interconnected by stripline. It has a high accuracy outer ring of 16 monopoles, an inner ring of 4 monopoles for resolving ambiguities, and a central reference monopole. The array receives the signals transmitted by any of the equipment types in the SECANT family, and the relative bearing is determined by measuring the phase difference between the signals in the reference monopole and in the rings. Random errors are minimized by integration of the high pulse rate, frequency hopped signals. Predicted overall error is 1 degree, one sigma with a bias component of 0.8 degree and a random component of 0.5 degree. An antenna array was constructed and tests in an anechoic chamber confirmed the validity of the design approach. GRA

N78-21069# Sandia Labs., Albuquerque, N. Mex. Guidance and Control Div.
ACCURACY LIMITATION ON STRAPDOWN CALCULATIONS IN A CONING ENVIRONMENT DUE TO A GIVEN APPROXIMATION TO THE BODY RATE VECTOR
Jerry N. Shinkle Sep. 1977 23 p refs
(Contract EY-76-C-04-0789)

(SAND-77-0726) Avail: NTIS HC A01/MF A01

The direction cosine matrix-differential equation [A] = [A] [omega] can be solved accurately only if a precise representation of the body rate vector omega is input to the navigation computer. An analytical solution for the limits of accuracy is presented that can be obtained when the omega vector is extracted from polynomial fits to integrating rate sensor output data. The results are applicable to all computational algorithms. ERA

N78-21070# Sandia Labs., Albuquerque, N. Mex.

SANDIA INERTIAL TERRAIN-AIDED NAVIGATION SYSTEM

Larry D. Hostetler and Richard C. Beckmann Sep. 1977 7 p (Contract EY-76-C-04-0789)

(SAND-77-0521) Avail: NTIS HC A02/MF A01

The concept of utilizing radar-derived terrain profile data for improving the guidance accuracy of weapon delivery systems has received considerable attention in the quest of zero CEP. One of the more successful concepts, to date, was the terrain contour matching (TERCOM) system being developed for cruise missile applications. Basically it obtained a position fix by correlating a radar-altimeter-derived terrain profile with stored topographical data. The location of the best match was taken to be the position of the vehicle. A sequence of such position fixes was used to update an inertial navigation systems. ERA

N78-21071# Advisory Group for Aerospace Research and Development, Paris (France).

APPLICATIONS OF ADVANCES IN NAVIGATION TO GUIDANCE AND CONTROL

Feb. 1978 279 p refs Partly in ENGLISH and FRENCH Presented at the 24th Technical Meeting of the Guidance and Control Panel, Stuttgart, 10-13 May 1977

(AGARD-CP-220; ISBN-92-835-0211-6) Avail: NTIS HC A13/MF A01

Conference proceedings on the application of advances in navigation to guidance and control are reported. Topics discussed include: (1) improvements in inertial navigation systems and their applications; (2) improvements in radar and radio navigation aids and their applications; (3) specific functions and system concepts; (4) new major systems; and (5) system improvements and concepts. For individual titles, see N78-21072 through N78-21091.

N78-21072# Raytheon Co., Sudbury, Mass.

FUTURE APPLICATIONS OF LOW COST STRAPDOWN LASER INERTIAL NAVIGATION SYSTEMS

James B. Matthews and Davis R. Bates, Jr. (SSD Marketing) *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 13 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

Fundamental principles of the laser gyro are reviewed to identify characteristics of this new means of measuring direction. The review of the development progression from Sagnac's ring interferometer through multibeam ring resonator to regenerative ring resonator is concise in order to emphasize considerations important in the comparison of the various laser gyro mechanization approaches. The treatment is intended to be augmented by reference material carefully selected and recommended for deeper study. Laser gyros based on dithered approaches to lock in circumvention are compared to the Raytheon multi-oscillator laser gyro in terms of performance requirements for precision pointing and high bandwidth versus navigation applications. A description of the Raytheon multioscillator approach is presented together with performance and physical data on current instruments.

Author

N78-21073# Singer Co., Little Falls, N. J. Kearfott Div.

NEW TECHNIQUES FOR LOW COST STRAPDOWN INERTIAL SYSTEMS

P. M. Brodie and C. R. Giardina *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 13 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

A number of techniques which can be employed to make a redundant strapdown configuration feasible is addressed. The major topics discussed are: concept of self contained redundancy, and modular reliability comparisons. J.C.S.

N78-21074# Societe Nationale Industrielle Aerospatiale, Toulouse (France).

INERTIAL SMOOTHING AND EXTRAPOLATION OF ILS BEAMS: APPLICATION TO THE AIRBUS A 300 B

J. Irvoas, D. Buisson, P. Lloret (SAGEM, Paris), and X. Lagarde (SAGEM, Paris) *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 49 p refs In ENGLISH and FRENCH (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

The hybrid radio inertial guidance system described in this report performs the following functions: (1) smoothing of the aircraft's flight path during an ILS automatic approach; (2) a very marked reduction in the lateral movements of the aircraft around its center of gravity and in the deflection of the control surface due to LOC beam noise; (3) the continuance of guidance in the event of failure of the LOC receiver; (4) in the event of serious or sudden failures which interfere with guidance of the aircraft, the LISS system dispenses with the need for LOC signals and reduces any deviation movements of the aircraft. The system requires only a relatively low performance inertial unit, although one with a higher performance would improve the overall system.

Author

N78-21075# Ferranti Ltd., Edinburgh (Scotland).

RECENT ADVANCES IN HIGH RESOLUTION INERTIAL NAVIGATION

K. R. Brown and R. A. R. Tait *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 10 p ref (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

An inertial navigator can survey to great accuracy and resolution if its self-generated velocity errors are determined by stopping and comparing the indicated velocity with the zero velocity at standstill. Three examples of the uses of this technology are described to demonstrate the performance that is possible. The relationship between survey and accuracy is examined and an estimate of the inertial instrument performance is made. It is found that the instruments are capable of far higher resolution than previously considered and to realize the benefit requires higher resolution interface units and a flexible computing system.

Author

N78-21076# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).

CALIBRATION OF AN INS BASED ON FLIGHT DATA

B. Stieler and W. Lechner *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 13 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

The results presented in this paper are based on an off line evaluation of flight data using optimal smoothing algorithms. This is an effective way to be followed for flight testing an INS and getting an insight into the sensor and system errors under flight conditions. The user of an INS, especially in the military field, is in general more interested in the in flight alignment and calibration of an INS, than in the on line evaluation of the data on board the aircraft for which optimal filtering algorithms are at hand. This opens the way for the fast take off of an aircraft with a coarse aligned platform. Corresponding simulation results are discussed.

Author

N78-21077# Rohde and Schwartz, Munich (West Germany).

UHF DF TRIANGULATION SYSTEM FOR CONTROL AND GUIDANCE OF MILITARY AIRCRAFT

Bernhard F. Ernst *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 7 p (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

A system for the guidance of aircraft from ground stations is discussed. The system consists essentially of a network of direction finders, and is intended to complement, rather than replace, conventional radars and other landing aids normally installed at airports. As a guidance technique, a network of direction finders offers the advantage of surface coverage, or it permits a form of surface navigation. The system has a further

advantage of particular significance in emergency situations such as may follow an error in navigation or a loss of fuel: nothing more than an operational radio set need be available on board the aircraft before use can be made of the DF guidance network. This feature can also be useful in the guidance of military aircraft since, as practice has shown, maneuvers at low level can often take the aircraft outside the airspace covered by ground-based radars. Author

N78-21078# Standard Electrik Lorenz A.G., Stuttgart (West Germany).

PRECISE ENROUTE NAVIGATION BASED ON GROUND-DERIVED TECHNIQUES

G. Blaschke and G. Peuker *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 13 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

A solution is offered by a ground-derived concept for azimuth measurement. It is based on the standard L-band DME, using also the existing airborne DME set. The DME interrogation pulses of the aircraft are received at the ground via a special antenna array by DF equipment that allows immediate determination of angle of incidence. This angle is sent back to the aircraft by a third pulse synchronized with the according DME reply. In the aircraft a search and track system extracts the 'angle reply', the time delay of which, relative to the DME reply, represents angle information. The signal format is the key element of the system, allowing for simplicity of airborne equipment and flexibility of ground stations. Basic error considerations show that errors due to airborne signal processing can be neglected and that the ground system can be adapted to a large extent to the special multipath environment. This allows the deployment of ground stations tailored to a special site leading to very economic solutions also on the ground. Implementation of airborne equipment is described followed by a more detailed presentation of ground station design (DME transponder, antenna array, receiver multiple, processing method, transmitter and data encoder, calibration and monitoring). Author

N78-21079# Standard Electrik Lorenz A.G., Stuttgart (West Germany).

ONE-WAY RANGING WITH TACAN

M. Boehm *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 15 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

Principles of TACAN, one-way and pseudo one-way ranging, and their possible application to TACAN, ground and airborne are discussed and described. Particular emphasis is put on synchronization techniques. The paper concludes with an outlook on some new operational applications which would be made possible by one-way ranging with TACAN. Author

N78-21080# Siemens A.G., Munich (West Germany). Central Telecommunications Labs.

AN ECM-RESISTANT COMMUNICATION AND RANGING SYSTEM FOR REMOTELY PILOTED VEHICLES

Hermann Sapp *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 8 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

A jam resistant communication and ranging system designated SIECON (Siemens ECM Resistant Communication and Navigation) is described. Accurate ECM resistant navigation and two way ECM resistant data transmission are significant requirements in remotely piloted vehicle systems. Both problems can be solved simultaneously by the SIECON system which achieves its high ECM resistance with the aid of pseudo noise phase shift keying modulation. The design, fabrication, and testing of various prototypes are discussed. The tests included flight tests with ECM resistant TV transmission equipment in order to demonstrate the negligible influence of multipath propagation on the communication system. J.C.S.

N78-21081# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehring.

ACCURACY CONSIDERATIONS ON NEW MICROWAVE LANDING SYSTEMS (MLS) FROM AN OPERATIONAL POINT OF VIEW

Alfred Becker *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 15 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

Some selected problems are dealt with related to the accuracy of the different systems from an operational point of view. Some general remarks to the International Civil Aviation Organization (ICAO) Microwave Landing Systems (MLS) competition are presented, along with ICAO Accuracy Requirements on the new MLS. Also presented are discussions on the performance of the system and flare guidance problems. Some perspective considerations are given as an indication of possible future performance improvements. Author

N78-21082# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.

A MULTI-SENSOR IMPLEMENTATION FOR NAVIGATION, POSITION LOCATION, POSITION UPDATE, RECONNAISSANCE, AND WEAPON DELIVERY: AN/ARN-101(V)

F. E. Pickel *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 9 p (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

The AN/ARN-101(V) is a digital system developed to replace and/or functionally improve the present avionics in the USAF F-4E and RF-4C aircraft. It upgrades the operational capability of the total weapon system through a multi-sensor implementation for navigation, offset aim point and target location, weapon delivery, and reconnaissance. The navigation, position locating, and position updating capabilities utilize a digital Inertial Measurement Unit (IMU), loran, fire control or mapping radar, Pave Tack, TISEO (Electro-Optical Target Identification System), and Lead Computing Optical Sight System (LCOSS) interfaces. Performance features include long-range and tactical navigation, all-weather blind bombing, adverse weather landing approach, uncanned weapon delivery profiles, and automatic reconnaissance steering. Author

N78-21083# Rockwell International Corp., Cedar Rapids, Iowa. Collins Avionics Div.

A 4D APPROACH CONTROL USING VOR/DME/ILS GUIDANCE

Juergen M. H. Bruckner and Thomas G. Sharpe *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 15 p (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

A study is presented to design, develop, and implement a 4D approach control system using conventional aircraft sensors and displays augmented with area navigation capability. The goal was to arrive at a system capable of retrofit with most air transport aircraft. Multifunction CRT (MAP) displays and inertial complementation were to be avoided. The only equipment item required in the final design is a Mark 2 type RNAV system capability used specifically to automatically define the nominal multiple-ordered-leg 4D RNAV approach path. The capability for close-in ILS captures (including those from above) was also included to allow for diverse aircraft separation and noise abatement requirements. Author

N78-21084# Technische Hogeschool, Delft (Netherlands). Dept. of Aerospace Engineering.

THE CALCULATION OF RMS VALUES OF DEVIATIONS OF AIRCRAFT CONTROLLED TO FLY ALONG A DESIRED FLIGHT PATH

J. C. VanDerVaart, H. L. Jonkers, and F. K. Kappetijn *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 22 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

A description is given for a method to calculate the covariance matrix, as a function of time, of a linear system perturbed by a number of random noise signals. Using basic principles of modern system theory it allows the computation of variance or r.m.s. values of aircraft variables in the case where system dynamics and statistical properties of the disturbing noise signals are a function of time. Results are shown of a numerical example of the symmetric motions of a present day jet transport in a coupled

approach followed by an automatic landing, the random disturbing signals being Gaussian atmospheric turbulence and ILS electronic noise. The problem of wind shear is briefly touched upon and an analytical approach to worst case wind time histories is presented. Author

N78-21085# Space and Missile Systems Organization, El Segundo, Calif.

APPLICATIONS OF THE NAVSTAR GLOBAL POSITIONING SYSTEM TO MILITARY GUIDANCE AND CONTROL

Bradford W. Parkinson *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 7 p (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

The NAVSTAR Global Positioning System (GPS) is a satellite-based navigation system that will provide extremely accurate timing and three-dimensional position and velocity information to properly equipped users anywhere on or near the earth. The system will be available continuously, worldwide, regardless of weather conditions, and will find extensive utilization in improved weapons delivery accuracies, range instrumentation, etc. Furthermore, it will provide an ultimate savings in the number and cost of navigation and position-fixing systems currently employed or projected. NAVSTAR GPS is a Joint Service Program with the Air Force as the executive service. The system concept evolved from Air Force and Navy programs which were initiated in the mid-1960's. The program is now in Phase 1 of three phases. Phase 1 (concept validation) calls for the deployment of six satellites in 1977-1978 which will permit demonstration and evaluation tests. The system will then be expanded in Phases 2 and 3 through deployment of additional satellites until the full-up operational 24 satellite configuration is achieved. This paper presents several applications of GPS and its potential impact on military guidance and control. Author

N78-21086# JTIDS Program Office, Hanscom AFB, Mass.

THE JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS)

B. Brentnall *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 12 p (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

JTIDS is a radio Communication Navigation Identification (CNI) system providing tactical elements for a broad range of services. Receiver-transmitter terminals are being developed for a range of applications including airborne, ground-based, and seaborne communications, command and control; CNI for tactical vehicles; data links for unmanned systems; and C(3) relay through unmanned stations and platforms. The system provides for jamming resistant digital data exchange, precision relative ranging between units, and positive identification and position correlation of users. Design of the system is based on a pseudo-noise modulated, frequency hopped signal characteristic which provides for jam-resistant, secure, data communication on a rigidly structured time division access basis. The various relative navigation techniques are described, and the relation to other navigation devices is discussed. Author

N78-21087# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

IMPROVED AIRCRAFT TRACKING USING MANEUVER STATISTICS ENROUTE AND IN THE TERMINAL AREA

Ulrich Brokof *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 9 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

By means of radar tracking it is possible to estimate continuously the dynamic state of an aircraft from discrete radar data. This is necessary, for instance, when investigating collision risks. In this paper autocorrelation functions have been computed from acceleration data. The autocorrelation function could be approximated by a model which corresponds to a periodic random variable. The model itself as well as the model parameters gives an indication of how to improve radar tracking algorithm (additional parameters). A simple and an extended model are practically tested in view of predicting properties. The same example is used to show how it is possible to improve radar tracking by aiding lateral acceleration with the roll angle information of the aircraft via a data link between the control centre and the aircraft. Author

N78-21088# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.

A HYBRID GUIDANCE SYSTEM FOR ALL-WEATHER APPROACH AND LANDING

Karlheinz Hurras *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 9 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

The micro-wave landing system (DLS) has been tested in Braunschweig. Apart from the DLS on-board equipment an inertial navigation system had been installed in a test aircraft for this purpose. One of the aims of these tests was to find out, to what degree the accuracy of the landing system could be improved by integrating this inertial navigation system. Both systems were combined by means of a Kalman filter. In this study, the way in which the filter operates during an approach is described. The errors of the DLS trial system set up at Braunschweig airport, could be reduced to about 20 percent by using the inertial navigation system. Author

N78-21089# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).

DEVELOPMENT OF THE INTEGRATED ALL-WEATHER NAVIGATION SYSTEM FOR TORNADO (MRCA)

H. F. Schwegler *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 8 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

A short rundown of the various development stages is given together with methods used and pitfalls encountered. From the experience gained in this project it seems that for the design of similar Kalman type navigation filters the most important tool is a data bank derived from flight tests together with well tested flexible evaluation software which allows the investigation of filter variants in a very short time on a ground based general purpose computer. Author

N78-21090# Ferranti Ltd., Edinburgh (Scotland).

NAVIGATION, GUIDANCE AND CONTROL FOR HIGH PERFORMANCE MILITARY AIRCRAFT

W. H. McKinlay *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 12 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

The paper discusses some of the factors involved in applying advanced navigation to an aircraft operating at low altitude for reconnaissance or to locate and attack ground targets. It considers the distinctions between navigation accuracy and the accuracy with which a pilot can follow a given flight profile. There are references to target acquisition and the need to pre-plan the profile. Recent Ferranti developments in the display of navigation information coupled with a level of automatic pre-planning are discussed. Author

N78-21091# Systems Control, Inc., West Palm Beach, Fla.

AREA NAVIGATION SYSTEMS AND PROCEDURES

Donald W. Richardson and James S. Tyler *In* AGARD Appl. of Advan. in Navigation to Guidance and Control Feb. 1978 9 p refs (For availability see N78-21071 12-04)

Avail: NTIS HC A13/MF A01

An attempt to identify, in pragmatic user-related terms, the operational significance of the overall concept of area navigation (RNAV) is presented. Its purpose is to explore, over a range of users and missions, the spectrum of functions and capabilities that this generic navigation technique offers. Starting with a summary of the correlation between current navigation systems both civilian and military and the concept of area navigation, the main content of the paper deals with two major issues, the current status of RNAV research, and future applications of RNAV. The current status is reviewed in the light of the results of extensive operational and cost benefit studies. Two illustrative examples of RNAV operational applications are discussed, namely the use of RNAV to facilitate complex noise abatement profiles,

and the application of RNAV techniques to improve the efficiency of airborne search and rescue operations. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N78-21092*# Northwestern Univ., Evanston, Ill. Transportation Center.

FACTORS AFFECTING THE RETIREMENT OF COMMERCIAL TRANSPORT JET AIRCRAFT Progress Report

Frank A. Spencer and Joseph A. Swanson 15 Feb. 1978 209 p refs

(Grant NsG-2149)

(NASA-CR-152115; PR-2) Avail: NTIS HC A10/MF A01 CSCL 01C

A brief historical background of the technology and economics of aircraft replacement and retirement in the prejet era is presented to see whether useful insights can be obtained applicable to the jet era. Significant differences between the two periods were demonstated. Current technological and operational economic perspectives were investigated in detail. Some conclusions are drawn to aircraft retirement policies. Author

N78-21093*# Boeing Vertol Co., Philadelphia, Pa.

RESEARCH REQUIREMENTS TO IMPROVE RELIABILITY OF CIVIL HELICOPTERS

John J. Dougherty, III and Lawrence D. Barrett Apr. 1978 114 p refs

(Contract NAS1-13624)

(NASA-CR-145335) Avail: NTIS HC A06/MF A01 CSCL 01C

The major reliability problems of the civil helicopter fleet as reported by helicopter operational and maintenance personnel are documented. An assessment of each problem is made to determine if the reliability can be improved by application of present technology or whether additional research and development are required. The reliability impact is measured in three ways: (1) The relative frequency of each problem in the fleet. (2) The relative on-aircraft manhours to repair, associated with each fleet problem. (3) The relative cost of repair materials or replacement parts associated with each fleet problem. The data reviewed covered the period of 1971 through 1976 and covered only turbine engine aircraft. Author

N78-21094*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EFFECT OF HIGH LIFT FLAP SYSTEMS ON THE CONCEPTUAL DESIGN OF A 1985 SHORT-HAUL COMMERCIAL STOL TILT ROTOR TRANSPORT

Michael D. Shovlin and Bruno J. Gambucci Apr. 1978 29 p refs

(NASA-TM-78474; A-7364) Avail: NTIS HC A03/MF A01 CSCL 01C

The performances of a derivative concept of a 1985 STOL tilt rotor transport, and of a second concept having a complex mechanical flap system similar to a short field B737 aircraft were compared for a 370 kilometer (200 nautical mile) short haul mission. The flap system of the latter allowed lift to be shifted from the rotor system to the wing, permitting a 26 percent reduction in dynamic component weight, while also permitting the use of a smaller wing. The wing and disc loading of this concept were 5746 (120 psf) and 1915 (40 psf) newtons per square meter, respectively, while the wing and disc loading of the derivative concept were 4788 (100 psf) and 1197 (25 psf) newtons per square meter, respectively. The high lift wing tilt rotor showed slightly improved fuel usage over its entire operating range and about 6 to 8 percent improvement in direct operating costs, resulting from its improved cruise efficiency and reduced weight. Other advantages include improved reliability with potentially reduced maintenance and better riding quality. Author

N78-21095*# Lockheed-California Co., Burbank. Commercial Advanced Design Div.

FUEL CONSERVATION MERITS OF ADVANCED TURBOPROP TRANSPORT AIRCRAFT Final Report, Jan. - Aug. 1977

J. D. Revell and R. H. Tullis Aug. 1977 154 p refs

(Contract NAS2-8612)

(NASA-CR-152096; LR-28283) Avail: NTIS HC A08/MF A01 CSCL 01C

The advantages of a propfan powered aircraft for the commercial air transportation system were assessed by the comparison with an equivalent turbofan transport. Comparisons were accomplished on the basis of fuel utilization and operating costs, as well as aircraft weight and size. Advantages of the propfan aircraft, concerning fuel utilization and operating costs, were accomplished by considering: (1) incorporation of propfan performance and acoustic data; (2) revised mission profiles (longer design range and reduction in; and cruise speed), and (3) utilization of alternate and advanced technology engines. Author

N78-21096*# Old Dominion Univ., Norfolk, Va. Research Foundation.

EXPERIMENTAL INVESTIGATION OF EFFECT OF JET DECAY RATE ON JET-INDUCED PRESSURES ON A FLAT PLATE Final Report

John M. Kuhlman, Don S. Ousterhout, and Ronald W. Warcup Washington NASA Apr. 1978 81 p refs

(Grant NGL-47-003-039)

(NASA-CR-2979) Avail: NTIS HC A05/MF A01 CSCL 01C

An experimental study of the interaction between a lift jet and an aircraft wing for a jet VTOL aircraft was performed for the simplified model of an unheated, subsonic, circular jet exiting at right angles to a flat plate into a uniform subsonic crosswind. The effects of jet dynamic pressure decay rate upon the jet location and jet induced pressure distribution on the plate were studied over a range of jet to crossflow velocity ratios of $2.2 < \text{or} = R < \text{or} = 10$. Jet decay rate was varied through use of cylindrical centerbodies with flat or hemispherical tips submerged in the jet nozzle at various depths below the jet exit plane. Quicker jet dynamic pressure decay, caused by the presence of a centerbody, resulted in reductions in the jet induced lift loss by as much as 45 percent relative to values for jets with no centerbody. These reductions in lift loss were observed at the larger values of crossflow velocity. Author

N78-21097# AiResearch Mfg. Co., Torrance, Calif.

DESIGN, FABRICATION, AND TESTING OF A FULL-SCALE BREADBOARD IN NITROGEN GENERATOR FOR FUEL TANK INERTING APPLICATION Final Technical Report, Jun. 1975 - Sep. 1977

Scott A. Manatt Sep. 1977 130 p refs Prepared in cooperation with Dow Chemical Co., Walnut Creek, Calif.

(Contract DOT-FA75WA-3658)

(AD-A049459; AiResearch-77-14376; FAA-RD-77-147) Avail: NTIS HC A07/MF A01 CSCL 01/3

Aircraft fuel tank ullage may contain a mixture of fuel vapor in air that presents a fire and explosion hazard. This hazard can be eliminated if the air is replaced by an inert gas containing insufficient oxygen to allow ignition. Fuel tank inerting systems using onboard storage of liquid nitrogen to supply the inert gas have been demonstrated by the FAA and others and have been retrofitted into some U. S. Air Force transport aircraft. Tests by NAFEC and the Air Force have shown that fuel ullage oxygen concentration must be reduced to 9 percent or less to protect against ignition sources. The use of hollow fiber permeable membranes in an onboard inert gas generator (IGG) fuel tank inerting system has been shown to be a feasible alternative to systems using stored liquid nitrogen, which must be periodically replenished. A program to optimize the permeable membrane geometry; generate data required for system design; and to design, fabricate, and test full-scale breadboard permeable membrane air separation modules was conducted using the McDonnell-Douglas DC-9 aircraft as a design baseline. Results of membrane development, full-scale breadboard module design, and testing are reported; a preliminary design is presented for a hollow fiber permeable membrane IGG system for the DC-9; and ownership considerations for the airborne system design, including a life cycle cost analysis, are discussed. Author (GRA)

N78-21098# Boeing Vertol Co., Philadelphia, Pa.
BEARINGLESS TAIL ROTOR LOADS AND STABILITY Final Report, Mar. 1975 - Jan. 1976
W. T. Edwards and W. Miao Nov. 1977 289 p refs
(Contract DAAJ02-75-C-0017; DA Proj. 1F2-62209-AH-76)
(AD-A049579; D210-11025-1; USAAMRDL-TR-76-16) Avail: NTIS HC A13/MF A01 CSCL 01/3

Four wind tunnel model tests were conducted on a model flex-strap bearingless tail rotor for aeroelastic stability characteristics and loads. In all, 12 individual rotor parameters were investigated to determine their effect on aeroelastic stability. All data required to define the structural and aerodynamic characteristics of the basic model and structural data required to define the test stand and drive system are presented. In addition, the physical properties required to describe the various parameters are documented, thus providing a complete description of each configuration tested. The effect of each test parameter on the aeroelastic stability boundaries is indicated through plots of actual measured boundaries. Where available, the alternating strap loads for these configurations are presented. A limited amount of analysis was conducted and seemed to correlate with the test results.
GRA

N78-21099# Raytheon Co., Sudbury, Mass.
A REVIEW OF METHODOLOGIES AND CONCEPTS TO MEASURE AND EVALUATE AIRCRAFT SURVIVABILITY/VULNERABILITY Final Report
R. Smith, A. S. Soltes, J. K. Wetzel, and L. R. Doyon Jan. 1978 109 p refs
(Contract F33615-73-C-0678)
(AD-A050152; ER74-4435; JTCG/AS-75-S-002) Avail: NTIS HC A06/MF A01 CSCL 01/3

This report is a summary of all significant studies performed by the Raytheon Company during the JTCG/AS TEAS program. The studies encompass primarily three areas: survivability assessment modeling, mission cost-effectiveness methodology, and survivability assessment studies. In the survivability assessment modeling area, several aircraft attrition models were evaluated to determine their applicability to the TEAS effort, and modeling deficiences were identified. In addition, attrition modeling requirements were outlined (again with the TEAS objectives in mind) to establish a more effective baseline model, and modeling validation techniques were studied to establish model credibility. A mission cost-effectiveness methodology is described to assist the Survivability Assessment Subgroup in the evaluation of the baseline aircraft. Following the definition of a generalized mission effectiveness/survivability model, a cost model based on the WESIAC method was outlined and a sample problem was described to demonstrate a typical application to the TEAS program. Finally, survivability assessment studies were performed to provide examples of how current survivability methodologies could be applied to the study of aircraft attrition.
GRA

N78-21100# Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.
A-4F BLUE ANGEL FLIGHT USAGE DATA, 1976 Final Report
K. I. Leikach and G. A. Bohannon 15 Oct. 1977 70 p refs
(AD-A050164; NADC-77287-60) Avail: NTIS HC A04/MF A01 CSCL 01/3

This report presents flight usage data which is used for monitoring individual Blue Angel aircraft structural fatigue life. Data identify operational trends that are beneficial/detrimental to prolonging aircraft fatigue life. A total of 2700.4 hours of counting accelerometer data and 363.2 hours of oscillograph data were processed and are presented. This data provides the basis for flight spectra development of Blue Angel mission utilizations as well as information concerning point in the sky assumptions required for fatigue analyses. Author (GRA)

N78-21101# Douglas Aircraft Co., Inc., Long Beach, Calif.
EVALUATION OF WINDSHIELD MATERIALS SUBJECTED TO SIMULATED SUPERSONIC FLIGHT Final Report, Jun. 1976 - Aug. 1977
J. B. Hoffman Sep. 1977 150 p refs
(Contract F33615-75-C-3105)
(AD-A049981; MDC-J7171; AFFDL-TR-77-92) Avail: NTIS HC A07/MF A01 CSCL 01/3

Candidate laminated and monolithic transparent plastic materials for aircraft windshields subjected to supersonic aerodynamic heating and pressure are evaluated by wind tunnel testing at realistic Mach numbers and altitudes for high performance aircraft. The reliability of the face-ply material is ascertained and the transparency optical effects are assessed during flight operating conditions and as a result of these conditions.
Author (GRA)

N78-21102# Naval Postgraduate School, Monterey, Calif.
REPORT ON AIRCRAFT FATIGUE STUDIES Interim Report, 1 Jul. 1976 - 30 Sep. 1977
Gerald H. Lindsey 30 Sep. 1977 36 p refs
(AD-A049876; NPS-67LI77091) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report summarizes a year of research activity on aircraft fatigue in three areas: (1) The influence of minimum load levels, ground loads, order of loading and counting method on the damage calculation, (2) The method of calculating local stress in the plastic range at the stress concentration site from the recorded in-flight strain monitor and (3) The measurement of relaxation of residual stresses after they are produced locally at the point of stress concentration. Substantial progress was made in all three areas and especially the first two. Author (GRA)

N78-21103# Hindustan Aeronautics Ltd., Bangalore (India).
MULTI-VARIATE OPTIMIZATION PROBLEMS OF FLIGHT VEHICLE SYNTHESIS
Sridhar M. Ramachandra Jan. 1978 42 p refs
(PB-276123/7) Avail: NTIS HC A03/MF A01 CSCL 01C

Attempts were made to delineate the multitechnology, multi-variate nature of the flight vehicle and the complex interactions between the various areas involved in its synthesis. Considerations arising in the choice and configuration layout of the hardware for tactical aircraft are outlined. A brief mathematical formulation of a system oriented approach to design is proposed for optimizing the flight vehicle parameters. GRA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N78-21104*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESULTS OF A SIMULATOR TEST COMPARING TWO DISPLAY CONCEPTS FOR PILOTED FLIGHT-PATH-ANGLE CONTROL
Wendell W. Kelley Mar. 1978 23 p refs
(NASA-TM-78692) Avail: NTIS HC A02/MF A01 CSCL 01D

Results of a simulator experiment which was conducted in order to compare pilot gamma-control performance using two display formats are reported. Pilots flew a variable flight path angle tracking task in the landing configuration. Pilot and airplane performance parameters were recorded and pilot comments noted for each case. Author

N78-21105# Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
FIBER OPTICS COST ANALYSIS PROGRAM (FOCAP) Final Report, 30 Jun. 1976 - 30 Jun. 1977
C. C. Zelon, J. E. Cassidy, and R. G. Shipley Sep. 1977 255 p refs
(Contract F33615-76-C-1260)
(AD-A049859; NA-77-729; AFAL-TR-77-190) Avail: NTIS HC A12/MF A01 CSCL 20/6

The significance of this research is that it establishes methods for comparing the life cycle cost of fiber optics and wire data transfer systems on large military aircraft, and uses those methods to perform cost analyses on the data transfer subsystems. Using the B-1 as an example, the applicability of fiber optics to the B-1 avionics/electrical systems was identified. Conceptual fiber optics data transfer systems were designed. The present

wire and the conceptual fiber optics designs formed a basis for computerized life cycle cost comparisons. Sensitivity analyses and cost trade-offs were performed to determine cost drivers in the application of fiber optics. Results show significance cost benefits can be gained by the implementation of fiber optics in data transfer subsystems having data rates in excess of 2 to 3 megabits per second. GRA

N78-21106# National Oceanic and Atmospheric Administration, Boulder, Colo. Weather Modification Program Office.
A SMALL AIRCRAFT GUST-PROBE SYSTEM
R. O. Gilmer and R. E. McGavin Nov. 1977 20 p refs
(PB-276429/8; NOAA-TM-ERL-WMPO-41; NOAA-77120104) Avail: NTIS HC A02/MF A01 CSCL 01C

A small aircraft system used in measuring the turbulent fluxes of moisture, sensible heat and momentum is described. This gust probe system is appropriate for boundary layer studies over areas of about 50 sq km up to the scales of large cities or river basins. Measurements of the turbulent fluxes over such local-to-regional areas are useful, for example, in investigations of mesoscale convection and convergence, many aspects of earth-atmosphere heat and water budgets, and dynamics of atmospheric interactions with lakes or coastal ocean waters. Recently, such a system was proposed for the study of evapotranspiration from various terrains. GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N78-21107*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RECTANGULAR CAPTURE AREA TO CIRCULAR COMBUSTOR SCRAMJET ENGINE
S. Zane Pinckney Mar. 1978 45 p refs
(NASA-TM-78657) Avail: NTIS HC A03/MF A01 CSCL 21E

A new concept for a scramjet engine design was presented. The inlet transformed a rectangular shaped capture stream into a cross section which was almost circular in shape at the inlet throat or combustor entrance. The inlet inner surface was designed by the method of streamline tracing. The high pressure and temperature regions of the combustor were almost circular in shape and thus the benefits of hoop stresses in relation to structural weight could be utilized to reduce combustor and engine weights. The engine had a center body consisting of a 20 deg included angle cone, followed by a constant diameter cylinder. Fuel injection struts were arranged in a radial array and were swept 54 deg from the center body to the inlet inner surface and had values of length to maximum average thickness between 5.6 and 6.6 which were felt to be structurally reasonable. Combustor wetted areas were shown to be less than those of the present fully rectangular engine concept. Author

N78-21108*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF THE NOISE CHARACTERISTICS OF TWO LOW PRESSURE RATIO FANS WITH A HIGH THROAT MACH NUMBER INLET
Howard L. Wesoky, John M. Abbott, and Donald A. Dietrich Jan. 1978 31 p refs
(NASA-TM-73880; E-9489) Avail: NTIS HC A03/MF A01 CSCL 21E

Acoustics data obtained in experiments with two low pressure ratio 50.8 cm (20 in.) diameter model fans differing in design tip speed were compared. Determination of the average throat Mach number used to compare high Mach inlet noise reduction characteristics was based on a correlation of inlet wall static pressure measurements with a flow field calculation. The largest noise reductions were generally obtained with the higher tip speed fan. At a throat Mach number of 0.79, the difference in noise reduction was about 3.5 db with static test conditions. Although the noise reduction increased for the lower tip speed fan with a simulated flight velocity of 41 m/sec (80 knots), it was still about 2 db less than that of the high tip speed fan which was only tested at the static condition. However, variations in acoustic performance could not be absolutely attributed to the different fan designs because of differences in inlet lip contours which resulted in small variations of peak wall Mach number and axial extent of supersonic and near-sonic flow. Author

N78-21109*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GAS PATH SEALING IN TURBINE ENGINES
Lawrence P. Ludwig 1978 44 p refs Presented at AGARD Power, Energetics, and Propulsion Panel Meeting on Seal Technol. in Gas Turbine Engines, London, 6-7 Apr. 1978
(NASA-TM-73890; E-9505) Avail: NTIS HC A03/MF A01 CSCL 21E

A survey of gas path seals is presented with particular attention given to sealing clearance effects on engine component efficiency. The effects on compressor pressure ratio and stall margin are pointed out. Various case-rotor relative displacements, which affect gas path seal clearances, are identified. Forces produced by nonuniform sealing clearances and their effect on rotor stability are discussed qualitatively, and recent work on turbine-blade-tip sealing for high temperature is described. The need for active clearance control and for engine structural analysis is discussed. The functions of the internal-flow system and its seals are reviewed. Author

N78-21110*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOGRAPHIC CHARACTERIZATION OF SPARK-IGNITION ENGINE FUEL INJECTORS
Peggy L. Evanich Feb. 1978 27 p refs
(NASA-TM-78830; E-9535) Avail: NTIS HC A03/MF A01 CSCL 21E

Manifold port fuel injectors suitable for use in general aviation spark-ignition engines were evaluated qualitatively on the basis of fuel spray characteristics. Photographs were taken at various fuel flow rates or pressure levels. Mechanically and electronically operated pintle injectors generally produced the most atomization. The plain-orifice injectors used on most fuel-injected general aviation engines did not atomize the fuel when sprayed into quiescent air. Author

N78-21111*# Pratt and Whitney Aircraft Group, East Hartford, Conn. Commerical Products Div.
EVALUATION OF FEDERAL AVIATION ADMINISTRATION ION ENGINE EXHAUST SAMPLING RAKE Final Report
A. J. Fiorentino, W. Greene, and R. Roberts Jun. 1977 61 p ref
(Contracts NAS3-19447; DOT-FA77WAI-708)
(NASA-CR-135213; PWA-5534; FAA-RD-77-115) Avail: NTIS HC A04/MF A01 CSCL 21E

A FAA exhaust emissions rake was tested in the Experimental Clean Combustor Program, Phase 3 to permit comparison of the values of gaseous emissions and smoke measured by the FAA rake with those measured with the NASA Pratt and Whitney Aircraft (P and WA) rake used in the Phase 3 Experimental Clean Combustor Program and with station seven probes. The results showed that the levels of CO, THC, NOx and smoke measured by the FAA and NASA/P and WA rakes agree well at high power, but that CO emissions measured by the FAA rake were approximately 10 percent higher than those measured by the NASA/P and WA rake at low power. Author

N78-21112*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRFLOW AND THRUST CALIBRATION OF AN F100 ENGINE, S/N P680059, AT SELECTED FLIGHT CONDITIONS
Thomas J. Biesiadny, Douglas Lee, and Jose R. Rodriguez Apr. 1978 27 p refs
(NASA-TP-1069; E-9257) Avail: NTIS HC A03/MF A01 CSCL 21E

An airflow and thrust calibration of an F100 engine, S/N

P680059, was conducted to study airframe propulsion system integration losses in turbofan-powered high-performance aircraft. The tests were conducted with and without thrust augmentation for a variety of simulated flight conditions with emphasis on the transonic regime. The resulting corrected airflow data generalized into one curve with corrected fan speed while corrected gross thrust increased as simulated flight conditions increased. Overall agreement between measured data and computed results was 1 percent for corrected airflow and -1 1/2 percent for gross thrust. The results of an uncertainty analysis are presented for both parameters at each simulated flight condition. Author

N78-21113*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLOW VISUALIZATION OF FILM COOLING WITH SPANWISE INJECTION FROM A SMALL ARRAY OF HOLES AND COMPOUND-ANGLE INJECTION FROM A LARGE ARRAY

Louis M. Russell Apr. 1978 18 p refs

(NASA-TP-1195; E-9340) Avail: NTIS HC A02/MF A01 CSCL 21E

Film injection from discrete holes in a smooth, flat plate was studied for two configurations: (1) spanwise injection through a four hole staggered array; and (2) compound angle injection through a 49 hole staggered array. The ratio of boundary layer thicknesses to hole diameter and the Reynolds number were typical of gas turbine film cooling applications. Streaklines showing the motion of the injected air were obtained by photographing small, neutrally buoyant, helium-filled soap bubbles that followed the flow field. Author

N78-21114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THEORETICAL FLOW CHARACTERISTICS OF INLETS FOR TILTING-NACELLE VTOL AIRCRAFT

Michael A. Boles, Rogers W. Luidens, and Norhert O. Stockman Apr. 1978 31 p refs

(NASA-TP-1205; E-9387) Avail: NTIS HC A03/MF A01 CSCL 21E

The results of a theoretical investigation of geometric variables for lift-cruise-fan, tilting nacelle inlets operating at high incidence angles are presented. These geometric variables are investigated for their effects on surface static to free stream pressure ratio, and the separation parameters of maximum to diffuser exit surface velocity ratio and maximum surface Mach number for low speed operating conditions. The geometric parameters varied were the internal lip contraction ratio, external forebody to diffuser exit diameter ratio external forebody length to diameter ratio and internal lip major to minor axis ratio. Author

N78-21115*# Rao and Associates, Inc., Palo Alto, Calif.

USE OF LEANING VANES IN A TWO STAGE FAN

G. V. R. Rao and R. V. Digumarthi Nov. 1975 53 p refs

(Contract NAS2-8680)

(NASA-CR-152134) Avail: NTIS HC A04/MF A01 CSCL 21E

The use of leaning vanes for tone noise reduction was examined in terms of their application in a typical two-stage high pressure ratio fan. In particular for stages designed with outlet guide vanes and zero swirl between stages, leaning the vanes of the first stage stator was studied, since increasing the number of vanes and the gap between stages do not provide the desired advantage. It was shown that noise reduction at higher harmonics of blade passing frequency can be obtained by leaning the vanes. Author

N78-21116*# Massachusetts Inst. of Tech., Cambridge.

NITRIC OXIDE FORMATION IN GAS TURBINE ENGINES: A THEORETICAL AND EXPERIMENTAL STUDY Ph.D. Thesis - Nov. 1975. Final Report

Thomas Mikus, John B. Heywood, and R. Edward Hicks Washington NASA Apr. 1978 106 p refs

(Grant NGR-22-009-378)

(NASA-CR-2977) Avail: NTIS HC A06/MF A01 CSCL 21E

A modified Zeldovich kinetic scheme was used to predict nitric oxide formation in the burned gases. Nonuniformities in fuel-air ratio in the primary zone were accounted for by a distribution of fuel-air ratios. This was followed by one or more dilution zones in which a Monte Carlo calculation was employed to follow the mixing and dilution processes. Predictions of NOX emissions were compared with various available experimental data, and satisfactory agreement was achieved. In particular, the model is applied to the NASA swirl-can modular combustor. The operating characteristics of this combustor which can be inferred from the modeling predictions are described. Parametric studies are presented which examine the influence of the modeling parameters on the NOX emission level. A series of flow visualization experiments demonstrates the fuel droplet breakup and turbulent recirculation processes. A tracer experiment quantitatively follows the jets from the swirler as they move downstream and entrain surrounding gases. Techniques were developed for calculating both fuel-air ratio and degree of nonuniformity from measurements of CO2, CO, O2, and hydrocarbons. A burning experiment made use of these techniques to map out the flow field in terms of local equivalence ratio and mixture nonuniformity. Author

N78-21117# Air Force Systems Command, Wright-Patterson AFB, Ohio.

FUEL PRESSURE INCREASE LIMITER

Yu. M. Akhmetov, V. I. Bolshagin, A. A. Ryzhov, V. S. Dyakonov, and M. A. Medvedeva 26 Jul. 1977 10 p Transl. into ENGLISH from Patent (USSR), no. 339672, 24 May 1972 p 1-2

(AD-A049393; FTD-ID(RS)T-1249-77) Avail: NTIS HC A02/MF A01 CSCL 01/3

The invention belongs to the field of the automatic control of turbojet engines, in particular, to fuel pressure increase limiters. Known are fuel pressure increase limiters, predominantly for a turbojet engine, which contain a spring-opposed servopiston with a rod, the cavities of which are connected by channels with a constant pressure valve, and a control slid valve. The purpose of the invention is to provide the optimal rate of pressure increase. To do this, made in the rod are additional channels connected to both cavities of the servodrive by means of holes which are provided in its body. GRA

N78-21118# Advisory Group for Aerospace Research and Development, Paris (France).

HIGH TEMPERATURE PROBLEMS IN GAS TURBINE ENGINES

Feb. 1978 585 p refs Presented at the 50th Meeting of the AGARD Propulsion and Energetics Panel, Ankara, 19-23 Sep. 1977

(AGARD-CP-229; ISBN-92-835-0209-4) Avail: NTIS HC A25/MF A01

The design and operation of gas turbines at high turbine inlet temperatures are considered. Emphasis is placed on turbine cooling techniques, high temperature materials and coatings, combustors, afterburners, and nozzles, the effect of cooling on aerodynamic performance, and prediction methods. For individual titles, see N78-21119 through N78-21158.

N78-21119# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

TECHNICAL EVALUATION REPORT ON 50TH PROPULSION AND ENERGETICS PANEL MEETING ON HIGH TEMPERATURE PROBLEMS IN GAS TURBINE ENGINES

R. Eggebrecht and S. Lombardo (Curtiss-Wright Corp., Wood-Ridge, N. J.) *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 16 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

A review is given of the technology associated with the design and operation of gas turbines at high turbine inlet temperatures. Test results from different cascade rigs, the effect of coolant injection on turbine aerodynamics, and external turbine blade heat transfer in the absence of boundary layer coolant injection are considered along with film cooling, influence of transpiration cooling on turbine blade boundary layers, and prediction methods for steady state and transient temperature distributions. Other topics discussed include the effect of turbine cooling on aerodynamic performance, combustors and afterburners, high temperature materials and coatings, and overall engine design and performance. J.M.S.

N78-21120# Rolls-Royce Ltd., Bristol (England). Aero Div.

PROJECT OPTIMISATION OF MILITARY GAS TURBINES WITH RESPECT TO TURBINE LIFE

E. A. White and M. J. Holland *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 17 p (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

Computerized analytical techniques developed for examining the characteristics of high pressure turbine blades under the various stresses of operation are considered. Emphasis is placed on turbine service life and cooling requirements for military aircraft in terms of and developing a cost effective weapon system.
J.M.S.

N78-21121# Turbomeca S. A. - Brevets Szydlowski, Bizanos (France).
PROBLEMS CONCERNING HIGH TEMPERATURES IN SMALL TURBOMACHINES [PROBLEMES DES HAUTES TEMPERATURES DANS LES PETITES TURBOMACHINES]
P. Belaygue *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 12 p In FRENCH (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

The power of small aeronautical turbomachinery is discussed in detail. Problems arising from elevating temperature and pressure at the turbine entrance which affect components such as the compressor, as well as the combustion chamber, and the turbine were examined. The aerodynamic and thermodynamic limitations that occur due to this rise in temperature and pressure are also summarized in relation to the small dimensions of the components. Transl. by B.B.

N78-21122*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROGRESS IN ADVANCED HIGH TEMPERATURE TURBINE MATERIALS, COATINGS, AND TECHNOLOGY
John C. Freche and G. Marvin Ault *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 31 p refs (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01 CSCL 21E

Advanced materials, coatings, and cooling technology is assessed in terms of improved aircraft turbine engine performance. High cycle operating temperatures, lighter structural components, and adequate resistance to the various environmental factors associated with aircraft gas turbine engines are among the factors considered. Emphasis is placed on progress in development of high temperature materials for coating protection against oxidation, hot corrosion and erosion, and in turbine cooling technology. Specific topics discussed include metal matrix composites, superalloys, directionally solidified eutectics, and ceramics.J.M.S.

N78-21123# Teledyne CAE, Toledo, Ohio.
THE STATUS OF SMALL, COOLED, AXIAL-FLOW TURBINES
H. F. Due, A. E. Easterling (Army AMRDL, Fort Eustis, Va.), and J. E. Haas (Army AMRDL, Cleveland) *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 15 p refs (For availability see N78-21118 12-07)
Avail: NTIS A25/MF A01

The design of a high performance small, cooled, axial flow turbine is considered in terms of aerodynamic performance, structural life, flow conditions, and cycle variations. Analytical techniques which predict losses, flow conditions, operating velocity triangles, and stage matching are reviewed. It is concluded that the design techniques are not adequate for meeting the requirements of high performance gas turbine engines without relying on semi-empirical relationships. J.M.S.

N78-21124# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).
ADAPTING A TURBINE ENGINE TEST STAND FOR HIGH TEMPERATURE RESEARCH [ADAPTATION D'UN BANC DE TURBINE AUX RECHERCHES POUR LES HAUTES TEMPERATURES]
J. Francois, Y. Le. Bot (ONERA, Paris), J. Michard (ONERA, Paris), and P. Deguest (CEP, Saclay, France) *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 10 p refs In FRENCH (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

A description of an apparatus for high temperature research is presented, and the influence of the turbine environment on the effectiveness of film thermal protection was studied. Detailed measurements were carried out on the assemblage provided the validation of the aerodynamic and thermal performance prediction of gas turbines. Transl. by B.B.

N78-21125# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
HOT CASCADE TEST RESULTS OF COOLED TURBINE BLADES AND THEIR APPLICATION TO ACTUAL ENGINE CONDITIONS
H. Koehler, D. K. Hennecke, K. Pfaff, and R. Eggebrecht *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 12 p refs (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

Experimental results of the cooling performance of various convection and film cooled turbine blade models in a two dimensional stationary cascade are presented. The Reynolds number and the cooling air/main stream mass flow ratio were varied within a range which is typical for turbine rotor blades in jet engines. From the analysis of the test results, basic understanding about the characteristics of cooling effectiveness and about the distribution of the hot gas side heat transfer coefficient was obtained. In applying model test results to a real engine, the differences between cascade and engine conditions, for example the rotation and the changed radiation environment, are taken into account. Some engine phenomena, such as free stream turbulence, which still have a largely unknown influence on heat transfer processes, are discussed. Blade temperature from engine tests are compared with cascade test results and theoretical temperature distributions. For a simulated engine acceleration process the temperature and the stress distributions in the mid-section of a turbine blade was computed using a time dependent finite element program. The results which serve as a basis for a comparative blade live assessment show that, during the transient phase, the mechanical loading of the blade by far exceeds the steady state valves. Author

N78-21126# Technische Hochschule, Aachen (West Germany). Inst. fuer Strahlantriebe und Turboarbeitsmaschinen.
INVESTIGATIONS OF THE LOCAL HEAT TRANSFER COEFFICIENT OF A CONVECTION COOLED ROTOR BLADE
W. Kuehl *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 11 p refs (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

Temperature measurements made within the convection air cooled rotor blade of a gas turbine during operation are used to determine the local heat transfer coefficients of turbine blades. The analytical method is described along with results which include the local gas side heat transfer and the complete temperature field within the blade. Unsteady flow effects are discussed.
J.M.S.

N78-21127# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.
INVESTIGATION ON TEMPERATURE DISTRIBUTION NEAR FILM COOLED AIRFOILS
H. Kruse *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 13 p (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

Using a practically adiabatic airfoil as a simple model of a turbine blade, some typical film cooling configurations were investigated. The dimensions and operating conditions were chosen so that both the Reynolds numbers and the ratio of hole diameter to boundary layer thickness would correspond to realistic values in the turbine. The temperature ratio between the mainstream and the coolant was in the range of 1.25 in order to get reasonable temperature differences. The temperature distributions within the gas and on the adiabatic wall were measured by means of miniaturized thermocouples. Information is given on the distribution of film cooling effectiveness and on the distribution of temperature in the near region downstream of the blowing point. To point out the influence of curvature near the nose of the airfoil some typical results were compared with those from flat plate measurements. Author

N78-21128# Middle East Technical Univ., Ankara (Turkey). Dept. of Mechanical Engineering.

EROSION PREVENTION AND FILM COOLING ON VANES

M. Saryal, I. M. Chantous, and A. Citici *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 8 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

A preliminary research on the behavior of solid particles approaching a cascade of leaf nozzles having air injected through a slit at the leading edge, was carried out. The results showed a definite prevention of erosion of solid particles at the leading edge region and the blade shoulder. The only vulnerable region was the pressure side trailing edge region. The ability of this method to provide means for effective cooling of gas turbine blades and possibilities of pulverized coal direct firming were studied. Results are summarized. Author

N78-21129# Sussex Univ., Brighton (England). Dept. of Mechanical Engineering.

PERFORMANCE AND DESIGN OF TRANSPIRATION-COOLED TURBINE BLADING

F. J. Bayley *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 15 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

Experimental and theoretical studies of transpiration cooled turbine blades are reviewed and a design method for such cooling system is proposed. An integral boundary layer method of analysis is shown to produce good agreement between observed and predicted heat transfer coefficients over most of the blade section where the effect of the coolant flow is significant, while a simple momentum-mixing theory appears adequate for assessing the effect of the coolant on the blade profile loss. Author

N78-21130# Ohio State Univ., Columbus.

THE INFLUENCE OF TRANSPIRATION COOLING ON TURBINE BLADE BOUNDARY LAYER

Lit S. Han and Leon Winget *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 14 p refs Sponsored in part by AF (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

The external boundary layer and the heat transfer distribution of a film cooled turbine blade are calculated. Results are used to determine the necessary film injection rate when the airfoil shape, the external gas, and the desired blade temperature are specified. J.M.S.

N78-21131# National Gas Turbine Establishment, Pyestock (England).

EXPERIMENTAL EVALUATION OF A TRANSPIRATION COOLED NOZZLE GUIDE VANE

W. H. Morris, J. B. Bullard, and L. D. Wigg *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 15 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

The design and experimental evaluation of a transpiration cooled nozzle guide vane is described. The thermal evaluation of the coolant system design at gas temperature up to 1615 K indicated achievment of design effectiveness levels and good uniformity of temperature distribution. However, the effect of transpiring flow on turbine stage efficiency was to bring about a significant loss in performance; relative to an uncooled nozzle a loss of about 5 per cent in efficiency at a coolant mass flow ratio of 3 per cent was observed. Application of the experimental data to transpiration cooling of nozzle guide vanes is discussed. Author

N78-21132# Technische Hogeschool, Delft (Netherlands). Lab. voor Verbrandingsmotoren en Gas-turbines.

HEAT TRANSFER CHARACTERISTICS OF THE CLOSED THERMOSYPHON SYSTEM

R. W. Stuart-Mitchell and J. Andries *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 13 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

A closed thermosyphon system of gas turbine blade cooling, using liquid metals and a secondary cooling circuit in a blade root, was studied. Experimentally determined heat transfer characteristics were determined for a 10.6 mm diameter cylindrical closed thermosyphon with a length diameter ratio 11.6:1 and a heated-to cooled-length ratio of 1:1 using water and mercury under a uniform heat flux, hot wall boundary condition. Results were obtained with the thermosyphon stationary and variously angled to the vertical between 0 deg and 45 deg and mounted in a rotating arm apparatus at rotational speeds between 500 r.p.m. and 1000 r.p.m. The results from the rotating experiments were correlated using a Grashof Number based on the gravitational acceleration, while the centrifugal acceleration was included in a third dimensionless parameter. Comparison of the results from the stationary and rotating experiments shows that angling the stationary thermosyphon to the vertical does not simulate the heat transfer in the rotating thermosyphon. Author

N78-21133# Sussex Univ., Brighton (England). School of Engineering and Applied Sciences.

HEAT TRANSFER FROM TURBINE AND COMPRESSOR DISCS

J. M. Owen *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 12 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

Mean and local Nusselt numbers were determined for three different rotating disc configurations. Heat transfer measurements are presented for: (1) a single disc rotating close to a stator with a radial outflow of coolant, representing the flow between an air cooled turbine disc and a casing; (2) a rotating cavity with a central axial throughflow of coolant, representing the flow between corotating compressor discs; and (3) a rotating cavity with a radial outflow of coolant, representing the flow between corotating air cooled turbine discs. Results are presented for a range of axial gaps, coolant flow rates and rotational speeds, and the similarities and differences between the three cases are discussed. In particular, it is shown that vortex breakdown dramatically alters the flow and heat transfer. Author

N78-21134# Centre de Villaroche, Moissy (France). Dept. Combustion-Pollution-Rechauffe.

A REVIEW OF TECHNIQUES FOR THE THERMAL PROTECTION OF THE WALLS OF THE COMBUSTION CHAMBER AND REHEATING DUCTS OF TURBOREACTORS [REVUE DES TECHNIQUES DE PROTECTION THERMIQUE DES PAROIS DES FOYER PRINCIPAUX ET DE RECHAUFFE DES TURBOREACTEURS]

M. Buisson, J. P. Gaillac, and B. Deroide *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 15 p refs In FRENCH (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

Techniques and limitations involved in the recooling of the combustion chamber in turboreactors were reviewed. A critical analysis of classical solutions such as forced convection, and film recooling showed the necessity for the utilization for more elaborate procedures, which include more simplified calculations. Transl. by B.B.

N78-21135# Lucas Aerospace Ltd., Burnley (England). Fabrications Div.

PRACTICAL SOLUTIONS TO THE COOLING OF COMBUSTORS OPERATING AT HIGH TEMPERATURES

J. Winter and H. Todd *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 14 p (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

Flame tube life potential for small gas turbine engine applications where high temperature operating conditions occur was studied. A small annular reverse flow combustion chamber was developed which utilizes a high proportion of the incoming air for wall film cooling purposes, prior to the redirection of the cooling air for combustion and mixing. The concept is shown to minimize the cooling difficulties encountered on conventional small annular chambers particularly when operating at elevated turbine entry temperatures. A combustor developed for a regenerative gas turbine engine where impingement cooling liners are employed to overcome problems of high metal temperatures on a low cost unit is described. Author

N78-21136# Technische Hochschule, Darmstadt (West Germany). Inst. fuer Technische Thermodynamik.

THE INFLUENCE OF COOLANT TURBULENCE INTENSITY ON FILM COOLING EFFECTIVENESS

R. Best *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 14 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

In pipe flow experiments cold air was injected tangentially to the tube wall of the test section through an annular slot into a hot fully developed turbulent pipe flow. The adiabatic wall temperature was measured along the pipe length for different velocity ratios, injection slot heights, and degrees of turbulence of coolant and main streams. Simultaneously the velocity and the temperature profiles as well as the distribution of the turbulent fluctuation velocities were measured. The measurements indicate that an increasing turbulence intensity of the coolant can significantly reduce film cooling effectiveness. By means of turbulent fluctuation velocity measurements and a physical model the film cooling effectiveness can be calculated. The derived correlations reveal cooling effectiveness with increasing turbulence. There is good agreement between experiments and theoretical predictions. Author

N78-21137# Centro per l'Automatica E. Piaggio, Pisa (Italy).

HIGH TEMPERATURE H2-AIR VARIABLE GEOMETRY COMBUSTOR AND TURBINE: TEST FACILITY AND MEASUREMENTS

L. Martorano and D. Dini *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 10 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

A design concept for gas turbine H2-air combustor is presented and its potential verified by experimental data. The combustor performance with a view to the use of H2-air in conventional variable geometry gas turbines was emphasized. Proposals and development for varying and controlling the air flow distribution characteristics appear feasible. Results are given of the first high temperature tests carried out on variable geometry combustor and turbine blading. Author

N78-21138# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

LOW FREQUENCY COMBUSTION INSTABILITY IN AUGMENTORS

F. N. Underwood, J. P. Rusnak (Pratt and Whitney Aircraft, West Palm Beach, Fla.), R. C. Ernst (Pratt and Whitney Aircraft, West Palm Beach, Fla.), E. A. Petrino (Pratt and Whitney Aircraft, West Palm Beach, Fla.), P. L. Russell (Pratt and Whitney Aircraft, West Palm Beach, Fla.), and R. Murphy, Jr. *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 19 p ref (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

An analytical model was developed to aid in designing afterburners that are free from low frequency instability. Rumble mechanisms investigated include the system airflow dynamics, combustion efficiency oscillations, fuel vaporization, recirculation wake energy, and turbulence upstream of the flameholders. Comparisons of the model predictions with experimental data are good. Author

N78-21139# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

NEW MATERIALS FOR HIGH TEMPERATURE TURBINES: ONERA'S DS COMPOSITES CONFRONTED WITH THE BLADE PROBLEMS

Herve Bibring *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 12 p refs In FRENCH; ENGLISH summary (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

The needs required for a blade material in aircraft turbines operating at higher temperatures are compared with the actual performance as found on Cotac DS composites testing. The structure and the properties of the more fully developed 74 and 741 types are discussed. In particular, the high temperature structural stability, the impact of thermal and mechanical fatigue, the oxidation resistance, and the coating capability are thoroughly evaluated. The great benefit in operational temperature of these materials can be immediately exploited in the field of uncooled solid blades. The problem of cooling passages in DS eutectic blades is also outlined. Author

N78-21140# Politecnico di Milano (Italy). Istituto di Chimica Fisica.

HIGH TEMPERATURE CORROSION OF Ni-BASE FOR TURBINE BLADES ALLOYS IN SULPHATE-CHLORIDE CONTAINING ENVIRONMENTS

U. Ducati, G. LecisCoccia, D. Cavallotti, and F. Borile (Cinisello Balsamo, Milan) *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 17 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

The effect of sulfates, chlorides and their mixtures on the corrosion behavior of some commercial Ni base superalloys was studied. For comparison some experimental alloys and a Co base superalloy were considered. The tests were performed on untreated samples and on samples submitted to various treatments specified to various solubilization aging, and grain growth. After an inspection of the thermogravimetric results, it was shown that the differences in behavior exhibited by the same base material submitted to various heat treatments are greater than those among different materials submitted to equal heat treatments. Author

N78-21141# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

PROTECTION OF COOLED BLADES OF COMPLEX INTERNAL STRUCTURE

Philippe Galmiche *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 9 p refs In FRENCH; ENGLISH summary (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

The problem of the general protection of cooled blades of complex internal structure was studied. A corresponding method called the SF technique, permits the realization in a single operation of the protection of both external and internal surfaces, as well as those of the orifices of cooling air, whatever their diameter. In a general way, the respective thickness of external and internal coatings may be precisely predetermined, with no parasitic particle being able to remain inside the parts after application of the protecting treatment. Results obtained by application of the SF method are illustrated by the presentation and examination of various parts of advanced turbomachines, which were handed over for treatment followed by tests or operational use by engine manufacturers or airlines. Author

N78-21142# Advisory Group for Aerospace Research and Development, Paris (France).

COBALT-BASE ALLOYS FOR HOT CORROSION PROTECTIVE COATINGS

A. Davin (CRM, Liege, Belgium), J. M. Drapier (CRM, Liege, Belgium), D. Coutsouradis (CRM, Liege, Belgium), and L. Habraken *In its* High Temp. Probl. in Gas Turbine Eng. Feb. 1978 12 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

In the field of gas turbine applications, the severe requirements of extended operation in marine environments or an increase in the inlet temperature, limit the life of the diffusion aluminide base coatings for nickel and cobalt superalloys. Protective overlay coatings such as Co/Ni-Cr-Al-Y-Ta were developed in order to satisfy the requirements of the gas turbine designers and showed an exceptional hot corrosion resistance. They were optimized to obtain an acceptable compromise between hot corrosion and thermal shock resistance. Experience gained with the development of such cobalt base and particularly Co-Al-Cr-Ta-Ni-Y alloys and corresponding coatings were evaluated by various techniques. Author

N78-21143# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.

TRENDS OF FUTURE TURBINE LIFE PREDICTION: TIME PHASE AUTOMATED ANALYSIS AND TEST VERIFICATION

J. L. Price and I. J. Gershon (AFAPL) *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 11 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A02/MF A01

A review of the most significant design parameters affecting turbine durability, and the structural analysis and verification techniques which are being developed for identification of structural inadequacies early in th propulsion system development cycle are reviewed. Author

N78-21144# Liege Univ. (Belgium). Institut de Mecanique.
FINITE ELEMENT ANALYSIS OF SOME PROBLEMS ARISING IN COOLED TURBINE BLADES
P. Beckers, G. Sander, and M. Hogge *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 16 p refs (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

The finite element method was applied successfully to a large number of engineering problems. The main approaches to some problems of heat transfer and stress computation that arise in the analysis of turbine blades were summarized. The introduction of nonlinear boundary conditions and temperature dependent material properties was considered in the heat transfer analysis. Various nonlinear effects were also taken into account in the static and dynamic stress analysis. It includes centrifugal forces, initial stresses, temperature dependent properties and elastoplastic behavior. Author

N78-21145# Lucas Aerospace Ltd., Burnley (England). Fabrications Div.
EVALUATION OF A CERAMIC COMBUSTION CHAMBER FOR A SMALL GAS TURBINE ENGINE
G. Sedgwick *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 10 p refs (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

A description is presented of the design, component evaluation and combustion testing of a reverse flow annular combustion chamber in silicon nitride. Heat transfer assessments were made of the temperature levels which components would reach during combustion testing. A thermal test program was formulated which enables thermal loadings well in excess of those estimated for the actual flame tube environment to be imposed upon specimen components. Thermal stress and probability of survival values were obtained using the method based on a Weibull statistical analysis using the weakest link volume critical flaw assumption. Finite element and brittle failure analyses were carried out on both thermal stress test specimens and the components making up the flame tube. Author

N78-21146# Massachusetts Inst. of Tech., Cambridge.
SYSTEMATIC STUDIES OF HEAT TRANSFER AND FILM COOLING EFFECTIVENESS
J. F. Louis *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 36 p refs (For availability see N78-21118 12-07) (Contracts F33625-76-C-2018; N00014-76-C-0253)
Avail: NTIS HC A25/MF A01

A review of studies in heat transfer and film cooling effectiveness was given to develop an in depth understanding of heat transfer and film cooling in gas turbines. A common experimental procedure is described for heat transfer measurements under isothermal wall conditions using fast response heat transfer gauges in tests conducted in a shock tunnel and a blowdown facility. The tests were conducted at flow and thermodynamic conditions modeling the operating conditions of advanced gas turbines. The configurations under study were single slot, single line of holes, double line of holes on a flat plate, and double line of holes on an airfoil. Author

N78-21147*# General Electric Co., Evendale, Ohio. Aircraft Engine Group.
EFFECTS OF FILM INJECTION ON PERFORMANCE OF A COOLED TURBINE
James D. McDonel and James E. Eiswerth *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 11 p refs (For availability see N78-21118 12-07)
(Contract NAS3-16732)
Avail: NTIS HC A25/MF A01

Tests were conducted in a 20 inch diameter single stage air cooled turbine designed to evaluate the effects of film cooling air on turbine aerodynamic performance. A comparison was made of the experimental results and an analytical method of evaluating film injection effects on turbine performance. The results are used to determine the effects of film cooling on overall engine performance for selected cycle conditions. The engine performance studies are used to show the cycle benefits of increased gas temperature at various coolant flow rates. Author

N78-21148# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
THE INFLUENCE OF JETS OF COOLING AIR EXHAUSTED FROM THE TRAILING EDGES OF A SUPERCRITICAL TURBINE CASCADE ON THE AERODYNAMIC DATA
Ortwin Lawnczeck *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 13 p refs (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

In a case of a stator cascade the influence of jets of coolant air on the aerodynamic behavior was tested. The jets exhaust from the trailing edges of four blades. By the evaluation of wake flow measurements over two pitches the losses and the downstream flow angle were determined. In addition schlieren pictures were taken. The downstream velocity was varied from a subsonic over a transonic up to a supersonic flow. The rate of the coolant air with respect to the primary air running through two adjacent blades was changed from zero to four percent. The measurements were carried out in the wind tunnel for two dimensional cascades. Author

N78-21149# Oxford Univ. (England). Dept. of Engineering Science.
A NEW TRANSIENT CASCADE FACILITY FOR THE MEASUREMENT OF HEAT TRANSFER RATES
D. L. Schultz, T. V. Jones, M. L. G. Oldfield, and L. C. Daniels *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 27 p refs (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

A type of transient cascade was developed for testing turbine blades and nozzle guide vanes at full scale engine Reynolds number and Mach number. It was based on a free piston compressor capable of producing uniform flow conditions for periods between 0.3 and 1.0 secs. Heat transfer rate measurements were made using thin film surface resistance thermometers deposited onto insulating substrated such as quartz or machinable glass ceramic. Flow visualization using schlieren and holographic techniques were also employed and typical results from rotor blades were presented. The principle of operation of the cascade is described together with the basis of its mechanical design and the predicted performance compared with experimental observations. The technique was shown to have advantages both in cost and effectiveness over continuous running cascades. Author

N78-21150# Wales Univ. Inst. of Science and Technology, Cardiff. Dept. of Mechanical Engineering and Engineering Production.
HEAT TRANSFER TO A PVD ROTOR BLADE AT HIGH SUBSONIC PASSAGE THROAT MACH NUMBERS
B. W. Martin, A. Brown, and S. E. Garrett *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 12 p refs (For availability see N78-21118 12-07)
Avail: NTIS HC A25/MF A01

Heat transfer measurements round a PVD rotor blade using a transient method were reported. Instrumented syndanio-asbestos blades forming part of a cascade were suddenly introduced into a heated air stream. The temperature time response of surface thermocouples attached to copper inserts in the blades then were used to determine local heat transfer coefficients for (1) passage throat Mach numbers between 0.79 and 0.94, (2) turbulence intensities from 4.15 to 9.05 percent, and (3) blade chord Reynolds numbers from 7.8 x 10,000 to 8.9 x 100,000. Measured transition lengths or the suction surface, over which the heat transfer nearly trebles, are somewhat short in relation to other measurements. The onset of transition, which is downstream of predictions for the higher Reynolds numbers but accords with the trends of existing correlations, is little influenced by turbulent intensity variators in the above range. Over the pressure surface the heat transfer is less than for a fully turbulent boundary layer. Author

N78-21151# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

MEASURING TECHNIQUES IN HIGH TEMPERATURE TURBINES

Yves LeBot, Marc Charpenel, and Pierre-Jacques Michard *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 12 p refs In FRENCH; ENGLISH summary (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

An instrument for performing on industrial machines measurements usually limited to laboratory studies was developed. Qualifications of the flow turbulence is described and an analysis of moble blade wakes by short response time pressure probes was included. Flow temperature fluctuations by thermocouple or resistor probes associated to signal processing electronics and by optical pyrometry were studied. Mobile blade surface temperatures were read by short response time optical pyrometry. The local thermal transfer coefficient on stator blades was measured by an analysis of evolution in time of the wall temperature after sudden cutting off of cooling air. The effectiveness of the wall thermal protection from results of a chromatographic analysis of gaseous samples was also calculated. The main characteristics of the instrumentation are presented and illustrated by examples of application on various test facilities. Author

N78-21152# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

THE MEASUREMENT OF FILM COOLING EFFECTIVENESS ON TURBINE COMPONENTS IN SHORT DURATION WIND TUNNELS

J. P. Ville and B. E. Richards *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 13 p refs In ENGLISH; FRENCH summary (For availability see N78-21118 12-07)

(Grant DA-ERO-75-G-074)

Avail: NTIS HC A25/MF A01

A method to measure an adiabatic wall effectiveness, n, and its associated heat transfer coefficient, h, of a film cooling system for turbine components in a short duration facility is described. Such a facility was used to provide flow conditions selected to simulate those of advanced aircraft turbines. The measurement of heat transfer rates under different coolant temperature conditions and the definition of a linear relationship between a heat transfer coefficient, h, based on mainstream recovery temperature and a nondimensional coolant temperature, leads to the evaluation of n, and h sub f. The measurements on a flat plate, cooled by air ejected through inclined holes at a Mach number of 0.6, unit Reynolds number of 2.4 x 10 to the 7th power per meter, wall to mainstream temperature ratio of 0.76, coolant to mainstream temperature of 0.70 to 0.95 and mass velocity ratio from 0.5 to 1.5 confirm the linearity of the h, theta relation and prove the ability of a short duration facility to provide useful film cooling data for blade cooling system development. Author

N78-21153# Politecnico di Milano (Italy).

LOCAL FLAME TEMPERATURE MEASUREMENTS BY RADIATIVE METHODS

U. Ghezzi, G. Zizsk (CNPM Politecnico, Milan), A. Coghe (CNPM Politecnico, Milan), F. Cignoli (CNPM Politecnico, Milan), and S. Benecchi (CNPM Politecnico, Milan) *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 8 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

The reliability of local flame temperature measurements by means of atomic fluorescence spectrometry was analyzed. Conventional radiative methods give a measure averaged over the optical path through the gas. Whenever the probe volume is not homogeneous, different layers, each having an individual temperature and thickness, contribute to the measure. Results obtained using an electronic signal processing system based on photo counting were reported and indicate that it is possible to obtain satisfactory space resolution and good reliability. Author

N78-21154# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

NEW COMPUTATION METHOD OF TURBINE BLADES FILM COOLING EFFICIENCY

Emile LeGrives and Jacques Jules Nicolas *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 12 p refs In FRENCH; ENGLISH summary (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

An analytical technique is presented for the computation of film cooling effectiveness of gas turbine blades. It is based on a mathematical description of the counter rotating vortex structure associated with the injection of coolant through discrete holes. The transport of mass induced by these vortices plays the major part in the mixing process of hot gas with the individual jets, which defines the adiabatic effectiveness of the resulting film. When merging of the jets and entrainment by turbulent diffusion effects were also taken into account, data from various experiments performed on flat plate were found to be in good agreement with predictions following this approach. Simple rules for computing film effectiveness with injection through several rows of holes allow an extension of the analysis to a large variety of injection patterns. Author

N78-21155# Sussex Univ., Brighton (England). Dept. of Mechanical Engineering.

THE EFFECT OF FREE-STREAM TURBULENCE UPON HEAT TRANSFER TO TURBINE BLADING

F. J. Bayley and R. W. Milligan *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 13 p ref (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

An initial investigation of the separate effects of free stream turbulence intensity and frequency upon the local heat transfer to a heavily loaded gas turbine blade section is described. It was shown that over the whole blade the rate of heat transfer is significantly increased by both those parameters, with the pressure surface showing the greatest response and the downstream half of the suction surface the least. Author

N78-21156# Sussex Univ., Brighton (England). Dept. of Mechanical Engineering.

FLOW AND HEAT TRANSFER IN ROTATING COOLANT CHANNELS

W. D. Morris *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 14 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

A selection of experimental results is presented which illustrates the influence of rotation on heat transfer in tubes that rotate about at axis either parallel to or perpendicular to the central tube axis. It was demonstrated that Coriolis and centripetal inertial effects can significantly alter the heat transfer characteristics in relation to the nonrotating case.Author

N78-21157# Pisa Univ. (Italy). Dept. of Engineering.

CALCULATION OF TEMPERATURE DISTRIBUTION IN DISKS AND COOLING FLOW IN A TRANSIENT STATE

M. Caprili and R. Lazzeretti *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 23 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

The temperature distribution in irregularly shaped disks and that of the cooling fluid was determined for a transient stator. The method of calculation used is described, and the stability of the numerical solution is discussed. The calculation program makes it possible to evaluate the influence of the functional parameters on temperature distribution. Author

N78-21158# Imperial Coll. of Science and Technology, London (England). Dept. of Chemical Engineering.

A COMPARISON BETWEEN PREDICTED AND MEASURED SPECIES CONCENTRATIONS AND VELOCITIES IN A RESEARCH COMBUSTOR

W. P. Jones (Natl. Gas Turbine Estab., Pyestock, Engl.), W. C. Clifford, C. H. Priddin (Rolls Royce Ltd., Derby, Engl.), and R. deChair (Rolls Royce Ltd., Briston, Engl.) *In* AGARD High Temp. Probl. in Gas Turbine Eng. Feb. 1978 16 p refs (For availability see N78-21118 12-07)

Avail: NTIS HC A25/MF A01

A comparison is presented between the predictions of a mathematical model of chemically reacting flow and measure-

ments of species concentrations and velocities in a small scale research combustor burning propane and air. The mathematical model is a three dimensional finite difference method for solving the time-averaged conservation equations in turbulent flow. The Reynolds stress terms are modelled with a two-equation model of turbulence and account is taken of the effect of turbulent fluctuations on the combustion reactions. Generally good agreement is obtained between predictions and measurements which include local gas velocities and the important chemical species (H2O, O2, N2, CO2, CO, and UHC). The tests were performed with an air inlet temperature of 570 K, a chamber pressure of 2.1 bar and an equivalence ratio of 0.69 in the primary zone (0.34 overall). Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N78-21159*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A NOTE ON MULTICYCLIC CONTROL BY SWASHPLATE OSCILLATION
James C. Biggers and John L. McCloud, III Apr. 1978 11 p refs
(NASA-TM-78475; A-7367) Avail: NTIS HC A02/MF A01 CSCL 01C

It was shown that for two, three, or four bladed rotors, simple oscillation of the nonrotating swashplate controls can produce prescribed blade pitch schedules of the sort which were suggested for vibration alleviation. Equations were given which relate the swashplate motions to the resulting blade pitch schedules. Author

N78-21160*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
RESULTS FROM FLIGHT AND SIMULATOR STUDIES OF A MACH 3 CRUISE LONGITUDINAL AUTOPILOT
Glenn B. Gilyard and John W. Smith Apr. 1978 85 p refs
(NASA-TP-1180; H-940) Avail: NTIS HC A05/MF A01 CSCL 01D

At Mach numbers of approximately 3.0 and altitudes greater than 21,300 meters, the original altitude and Mach hold modes of the YF-12 autopilot produced aircraft excursions that were erratic or divergent, or both. Flight data analysis and simulator studies showed that the sensitivity of the static pressure port to angle of attack had a detrimental effect on the performance of the altitude and Mach hold modes. Good altitude hold performance was obtained when a high passed pitch rate feedback was added to compensate for angle of attack sensitivity and the altitude error and integral altitude gains were reduced. Good Mach hold performance was obtained when the angle of attack sensitivity was removed; however, the ride qualities remained poor. Author

N78-21161*# Princeton Univ., N. J. Instrumentation and Control Lab.
OPTIMAL CONTROL THEORY (OWEM) APPLIED TO A HELICOPTER IN THE HOVER AND APPROACH PHASE
Gerard J. Born and Tadao Kai Jan. 1975 289 p refs
(Contract NAS2-7187)
(NASA-CR-152135; Rept-1205) Avail: NTIS HC A13/MF A01 CSCL 01C

A major difficulty in the practical application of linear-quadratic regulator theory is how to choose the weighting matrices in quadratic cost functions. The control system design with optimal weighting matrices was applied to a helicopter in the hover and approach phase. The weighting matrices were calculated to extremize the closed loop total system damping subject to constraints on the determinants. The extremization is really a minimization of the effects of disturbances, and interpreted as a compromise between the generalized system accuracy and the generalized system response speed. The trade-off between the accuracy and the response speed is adjusted by a single parameter, the ratio of determinants. By this approach an objective measure can be obtained for the design of a control system. The measure is to be determined by the system requirements. Author

N78-21162# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
SYSTEM OPTIMIZATION BY PERIODIC CONTROL Interim Scientific Report, 1 Oct. 1976 - 1 Oct. 1977
Elmer G. Gilbert 1977 6 p refs
(Grant AF-AFOSR-3158-77)
(AD-A049522; AFOSR-78-0012TR) Avail: NTIS HC A02/MF A01 CSCL 01/3

Research was conducted in two areas: the theory and computation of periodic controls, and the input-output characterization of nonlinear systems. The effort on periodic control was devoted almost entirely to: sufficient conditions for optimality, a computational study of periodic aircraft cruise, the use of variational models for analyzing the effect of system nonlinearities in the presence of periodic forcing. The investigation of input-output characterizations for nonlinear systems was extended to the realization problem for nonlinear systems. Author (GRA)

N78-21163# Boeing Vertol Co., Philadelphia, Pa.
HEAVY LIFT HELICOPTER FLIGHT CONTROL SYSTEM. VOLUME 2: PRIMARY FLIGHT CONTROL SYSTEM DEVELOPMENT AND FEASIBILITY DEMONSTRATION Final Report, Jul. 1971 - Jul. 1975
T. H. Sanders and B. L. McManus Sep. 1977 122 p refs
(Contract DAAJ01-71-C-0840)
(AD-A049580; USAAMRDL-TR-77-40B-Vol-2) Avail: NTIS HC A06/MF A01 CSCL 01/3

The U.S. Army's Heavy Lift Helicopter Advanced Technology Component Program required the design, development, and inflight feasibility demonstration of an electrohydraulic flight control system, referred to as fly-by-wire. Total flight testing encompassed evaluation and demonstration in two parts. First, a direct electrical linkage was successfully demonstrated in September 1973. Subsequently, an automatic flight control system was installed and evaluated with the direct electrical linkage. This volume describes the primary flight control system; its design features, installation test. Included also is a report of a related activity to design and evaluate, in laboratory tests, a compatible cockpit controller subsystem in which pilot commands are converted to electrical signals. Standard pilot interface features, such as magnetic brakes, stick position trim, and force trim are included. To interface with the automatic flight control system, controller driver actuators are included. GRA

N78-21164# Boeing Vertol Co., Philadelphia, Pa.
HEAVY LIFT HELICOPTER FLIGHT CONTROL SYSTEM. VOLUME 3: AUTOMATIC FLIGHT CONTROL SYSTEM DEVELOPMENT AND FEASIBILITY DEMONSTRATION Final Report, Jul. 1971 - Jul. 1975
J. Davis, T. Barnett, and J. Gaul Sep. 1977 705 p refs
(Contract DAAJ01-71-C-0840)
(AD-A050059; USAAMRDL-TR-77-40C-Vol-3) Avail: NTIS HC A99/MF A01 CSCL 01/3

The U.S. Army Heavy Lift Helicopter Advanced Technology Component program required the design, development, and feasibility demonstration of an electrohydraulic flight control system. This volume details the evolution of an automatic flight control system (AFCS), operating by means of a direct electrical linkage. AFCS software and hardware development and testing are discussed. The results of flight clearance testing and in-flight evaluations of AFCS control laws are examined. GRA

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

N78-21165# Air Force Civil Engineering Center, Tyndall AFB, Fla.
RUNWAY ROUGHNESS EVALUATION LASER PROFILOMETER IMPLEMENTATION STUDY Final Report, Nov. 1975 - Sep. 1977
Dannie O. Burk and James I. Clark Oct. 1977 66 p refs
(AD-A049440; AFCEC-TR-78-1) Avail: NTIS HC A04/MF A01 CSCL 20/5

Runway profiles and aircraft vertical acceleration responses were analyzed to develop an evaluation methodology for runway roughness and to develop roughness standards against which runways can be evaluated. Root mean square values of filtered profile data and vertical aircraft accelerations were statistically developed on a segmental basis into runway roughness standards. A methodology was developed to evaluate runway profiles against these standards; and to recommend corrective construction of the profile to reduce aircraft response. Profile roughness has therefore been based on a numerically relative basis. The establishment of runway roughness standards and evaluation methodology is considered incomplete, and additional work is recommended in this report. Author (GRA)

N78-21166# Naval Postgraduate School, Monterey, Calif.
A SUB-SCALE TURBOJET TEST CELL FOR DESIGN EVALUATIONS AND ANALYTICAL MODEL VALIDATION Interim Report
Holden W. Hewlett, P. J. Hickey, and David W. Netzer Sep. 1977 48 p refs
(AD-A049862; NPS-67NT77091) Avail: NTIS HC A03/MF A01 CSCL 14/2

A one-eighth scale (1/64 scale on mass flow) NARF Alameda turbojet test cell was designed and constructed. The test cell is to be employed for evaluation of optimum augmentor design and pollution abatement methods and for validation of analytical models. Initial evaluation of the test cell demonstrated its versatility and ease of operation as well as some deficiencies. Model operating characteristics and planned investigations are discussed. GRA

N78-21167# Tennessee Univ. Space Inst., Tullahoma.
SUMMER FACULTY SYSTEMS DESIGN PROGRAM. INTEGRATING WIND TUNNELS AND COMPUTERS. VOLUME 2: DETAILS OF SUMMER DESIGN STUDY USAF/OSR/ASEE Final Report, 13 Jun. - 19 Aug. 1977
Bernard W. Marschner, Robert L. Young, L. Eugene Broome, Donald A. Chambless, Sin-I Cheng, Frank G. Collins, James R. Cunningham, Gregory M. Dick, Salvador R. Garcia, William A. Hornfeck et al Aug. 1977 288 p refs
(Grant AF-AFOSR-3289-77)
(AD-A050071; AFOSR-78-0057TR-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 20/4

The design problem that was selected for this report was the general area of the interaction between developments in computers and the obtaining of design data from wind tunnels. The rather broad scope of this topic made it necessary to restrict the consideration of the study to the following areas: Control of the Tunnel Parameters for Wind Tunnel Tests; Control of Model Parameters; Improvements in Tunnel Simulation Qualities; and Computational Fluid Dynamics in the Design Cycle. GRA

N78-21168# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
COST-EFFECTIVENESS OF FLIGHT SIMULATORS FOR MILITARY TRAINING. VOLUME 2: ESTIMATING COSTS OF TRAINING IN SIMULATORS AND AIRCRAFT Final Report, Apr. 1976 - Jul. 1977
Jesse Orlansky and Joseph String Aug. 1977 172 p refs
(Contract DAHC15-73-C-0200)
(AD-A049979; AD-E500014; P-1275-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 05/9

Flight simulators cost less to operate than do aircraft; estimates range from 5 to 20%. Many studies have shown that skills learned in flight simulators can be performed successfully in aircraft, i. e., the use of flight simulators for training purposes saves flight time. The critical issue is whether the amount of flight time saved by the use of simulators is worth their cost. The cost-effectiveness of flight simulators for training has been demonstrated only in a few recent studies which report that the procurement cost of simulators can be amortized in a few years. Current R/D about flight simulators centers about the need for motion and wide angle visual display systems. Flight simulators have achieved their greatest use by the military so far in undergraduate flight training. Their greatest potential for future savings lies in transition and continuation training which account for the major costs of military flying. Consistent methods of data collection and cost estimating, not now available, are needed to evaluate the cost-effectiveness of alternative flight training programs, including the use of various types of simulators, part-task trainers, new instructional strategies, and the like. The report provides a preliminary cost model which identifies the data needed to develop cost estimates for use in cost-effectiveness analyses of flight training. Author (GRA)

N78-21169# Naval Training Equipment Center, Orlando, Fla. Human Factors Lab.
TRAINING DEVICE DESIGN: THE SIMULATION/ STIMULATION CONTROVERSY Final Report, Apr. 1976 - Apr. 1977
Melvin D. Montemerlo Jul. 1977 81 p refs
(AD-A049973; NAVTRAEQUIPCEN-IH-287) Avail: NTIS HC A05/MF A01 CSCL 05/9

Hands-on practice is a necessary aspect of most instructional programs, and training devices are an accepted method for providing such practice. However, the relative effectiveness of two different types of training devices, synthetic trainers and actual equipment trainers, for providing this practice is a matter of controversy. In the absence of a definitive answer, many training organizations have adopted policies limiting procurement to one type of device or to the other. Yet, the successes that have been achieved with both types indicate that neither is inherently superior to the other. This report enumerates seven factors which have been found to affect the relative effectiveness of synthetic and actual equipment trainers in particular situations: they are cost, reliability, maintainability, safety, facility requirements, training features, and modifiability. Examples are provided from the fields of: vehicle operator training (e.g., pilots, helmsmen, astronauts), equipment operator training (e.g., power plant, and sonar operators) and maintenance training. Special chapters are included on pierside trainers and on synthetic maintenance trainers. The purpose of this report is to aid those in a position to select synthetic and actual equipment trainers by making available to them the findings of others in a variety of training situations. Author (GRA)

N78-21170# Army Construction Engineering Research Lab., Champaign, Ill.
DEVELOPMENT OF A PAVEMENT MAINTENANCE MANAGEMENT SYSTEM. VOLUME 2: AIRFIELD PAVEMENT DISTRESS IDENTIFICATION MANUAL Final Report, Jul. 1974 - Jul. 1976
Mohamed Y. Shahin, Michael I. Darter, and Starr D. Kohn Tyndall AFB, Fla. Civil and Environ. Eng. Develop. Office Dec. 1977 115 p Supersedes AFCEC-TR-76-27-Vol-2
(AF MIPR-FQ8952-76-66005)
(AD-A049029; CERL-TR-C-76-Vol-2; CEEDO-TR-77-44-Vol-2; AFCEC-TR-76-27-Vol-2) Avail: NTIS HC A06/MF A01 CSCL 01/5

This manual is designed to provide airfield pavement inspectors with a comprehensive reference for pavement distress identification. The information is to be used in conjunction with procedures presented in Volume I of this report to determine pavement condition and maintenance and repair requirements. The types of airfield pavement distress are listed alphabetically under the major categories of asphalt- or tar-surfaced pavements and jointed concrete pavements. Names, descriptions, severity levels, photographs, and measurement or count criteria are presented for each distress type. Author (GRA)

N78-21171# Tennessee Univ. Space Inst., Tullahoma.
SUMMER FACULTY SYSTEMS DESIGN PROGRAM. INTEGRATING WIND TUNNELS AND COMPUTERS. VOLUME 1: EXECUTIVE SUMMARY. USAF/OSR/ASEE Final Report, 13 Jun. - 19 Aug. 1977
Bernard Marschner, Robert L. Young, L. Eugene Broome, Donald A. Chambless, Sin-I Cheng, Frank G. Collins, James R. Cunningham, Gregory M. Dick, Salvador R. Garcia, William A. Hornfeck et al Aug. 1977 30 p

(Grant AF-AFOSR-3289-77)
(AD-A050072; AFOSR-78-0058TR-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 20/4

It was necessary to review the fields of wind tunnel testing and computational fluid dynamics in order to understand better how computers and wind tunnels can be used, independently and interactively, to the benefit of aerodynamic design and testing. In the material in Volume 2 there is a fair amount of tutorial material that may be omitted if the reader is current in the field. The study group has attempted to concentrate on those areas in the timely generation of the design data in which the computer can most probably effect significant improvement.

GRA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration*.

N78-21172*# National Aeronautics and Space Administration, Washington, D. C.
GERMINATION OF PINE SEED IN WEIGHTLESSNESS (INVESTIGATION IN KOSMOS 782)
R. N. Platonova, G. P. Parfenov, V. P. Olkhovenko, N. I. Karpova, and M. Ye. Pichugov Mar. 1978 15 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (USSR), no. 5, Sep. - Oct. 1977 p 770-776 Original language document was announced as A78-18523 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-2790)
(NASA-TM-75281) Avail: NTIS HC A02/MF A01 CSCL 22A

An investigation was made of the orientation of above-ground and underground organs of pine plants grown from seed in weightlessness. Orientation was found to be caused by the position of the seeds relative to the substrate surface. Normal growth was manifest only for the plants grown from seed oriented with embryo toward the substrate. Differences were noted between experiment and control as to the quantitative content of nucleoli in the meristematic cells of the rootlets and the shape of cells in the cotyledonous leaflets. No complete agreement was found between data obtained in weightlessness and when gravity was compensated (clinostat treatment with horizontal rotation). Author

N78-21173*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN INTERSTELLAR PRECURSOR MISSION
L. D. Jaffe, C. Ivie, J. C. Lewis, R. Lipes, H. N. Norton, J. W. Stearns, L. Stimpson, and P. Weissman 30 Oct. 1977 111 p refs
(Contract NAS7-100)
(NASA-CR-156152; JPL-Pub-77-70) Avail: NTIS HC A06/MF A01 CSCL 22A

A mission out of the planetary system, with launch about the year 2000, could provide valuable scientific data as well as test some of the technology for a later mission to another star. Primary scientific objectives for the precursor mission concern characteristics of the heliopause, the interstellar medium, stellar distances (by parallax measurements), low energy cosmic rays, interplanetary gas distribution, and mass of the solar system. Secondary objectives include investigation of Pluto. Candidate science instruments are suggested. Individual spacecraft systems for the mission were considered, technology requirements and problem areas noted, and a number of recommendations made for technology study and advanced development. The most critical technology needs include attainment of 50-yr spacecraft lifetime and development of a long-life NEP system. Author

N78-21174*# National Aeronautics and Space Administration, Washington, D. C.
APOLLO OVER THE MOON: A VIEW FROM ORBIT
Harold Masursky, ed., G. W. Colton, ed., Farouk El-Baz, ed., Frederick J. Doyle, Richard E. Eggleton, Maurice J. Grolier, James W. Head, III, Carroll Ann Hodges, Keith A. Howard, Leon J. Kosofsky et al 1978 263 p refs Original contains color illustrations
(NASA-SP-362; LC-77-25922) Avail: NTIS MF A01; SOD HC $9.25 CSCL 03B

The Apollo metric camera system was flown to acquire photographic data with accuracy to aid the effort of moon mapping. The panoramic camera was selected to provide high resolution photography of lunar surface features for detailed analysis and photointerpretation. A portion of these photographs is presented. Various views and subjects include the following: (1) Regional views;(2) The Terrae; (3) The Maria; (4) Craters; (5) Sinuous and Straight Rimae; and (6) Unusual features. Author

N78-21175*# General Dynamics/Astronautics, San Diego, Calif.
PAYLOAD PLANNING INFORMATION DEVELOPMENT STUDY Final Report
31 Mar. 1978 121 p
(Contract NAS8-32702)
(NASA-CR-150633; CASD-NAS-78-005) Avail: NTIS HC A06/MF A01 CSCL 22A

The results of the Payload Planning Information Sheets Development Study were summarized. The two payload planning questionnaires that were developed in this study are included. Author

N78-21176*# National Aeronautics and Space Administration, Washington, D. C.
SPACE ORBITS OF COLLABORATION
B. Petrov Apr. 1978 14 p Transl. into ENGLISH from Tekh. i Nauka (USSR), no. 11, 1977 p 10-12 Transl. by Sci. Transl. Serv., Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75096) Avail: NTIS HC A02/MF A01 CSCL 22A

The U.S.S.R. cooperative space efforts with other Socialist countries dating back to 1957 are reviewed. The Interkosmos program, which is divided into three series of satellites (solar, ionospheric and magnetospheric), is discussed as well as the Prognoz, Kosmos, Soyuz, and Molniya spacecraft. Collaboration with France, India, Sweden, and the United States is mentioned. Author

N78-21177*# National Aeronautics and Space Administration, Washington, D. C.
TSIOLKOVSKY'S IDEAS ON COSMONAUTIC PROBLEMS
Dec. 1977 449 p refs Transl. into ENGLISH of the collection "Idei Tsiolkovskogo i Problemy Kosmonautiki" Moscow, Mashinostroyeniye Press, 1974 p 1-384 Sponsored by NASA Transl. by Franklin Book Programs, Inc., Cairo
(Contract NSF C-724)
(NASA-TT-F-16118; TT-75-58006) Avail: NTIS HC A19/MF A01 CSCL 22A

The philosophical, scientific, technical, medical, biological, and other cosmonautic problems were examined in detail. Various aspects of the development of aviation and aeronautics were also included. Author

N78-21178# Lockheed Missiles and Space Co., Palo Alto, Calif.
DIVISION 2: MATERIALS IN SPACE ENGINEERING. CHAPTER 3: INFLUENCE OF THE SPACE MEDIUM ON MATERIALS
[1977] 7 p Transl. into ENGLISH from the book "Inzhenernyi Spravochnik po Kosmicheskoi Tekhnike" Moscow, Voenizdat, 2d edition, 1977 p 142-148
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The deep vacuum, radiation, and low temperature characteristics of space medium exert a substantial influence primarily on the structure of metallic and nonmetallic materials, and consequently, on a whole complex of their properties. Undesirable changes in the properties of materials reduce the reliability of space vehicle operation and should certainly be taken into account during construction. With this in mind the following topics are discussed: (1) influence of deep vacuum on materials, (2) influence of radiation exposure on the construction and properties of materials, (3) influence of low temperatures on structural metals and alloys. Author

N78-21179*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
CONSTRUCTION IN SPACE: A PROPOSED EXPERIMENT

IN SUPPORT OF THE SPACE SOLAR POWER CONCEPT AND OTHER LARGE SPACE SYSTEMS
30 Mar. 1977 17 p
(NASA-TM-79435) Avail: NTIS HC A02/MF A01 CSCL 22A

The conceptual equipment and techniques for fabricating and assembling a ladder-like structure of triangular cross section trusses suitable for mounting solar cell arrays are described. The detail information is presented in the context of a proposed experiment to be conducted from the shuttle in the 1980-84 time period as an early experiment in the development of techniques for the construction of large space structures that would be required for space solar power stations and other large systems. Author

N78-21180*# Lunar Science Inst., Houston, Tex.
UTILIZATION OF LUNAR MATERIALS AND EXPERTISE FOR LARGE SCALE OPERATIONS IN SPACE: ABSTRACTS
David R. Criswell, ed. 1976 198 p refs Special Session held at Houston, Tex., 16 Mar. 1976
(NASA-CR-156167) Avail: NTIS HC A09/MF A01 CSCL 22A

The practicality of exploiting the moon, not only as a source of materials for large habitable structures at Lagrangian points, but also as a base for colonization is discussed in abstracts of papers presented at a special session on lunar utilization. Questions and answers which followed each presentation are included after the appropriate abstract. Author and subject indexes are provided. A.R.H.

N78-21181*# Biospherics, Inc., Rockville, Md.
TECHNOLOGY FOR RETURN OF PLANETARY SAMPLES, 1977 Annual Report
10 Apr. 1978 153 p refs
(Contract NASw-2856)
(NASA-CR-156169) Avail: NTIS HC A08/MF A01 CSCL 22A

Recent progress on the development of a basic warning system (BWS) proposed to assess the biohazard of a Mars sample returned to earth, an earth orbiting spacecraft, or to a moon base was presented. The BWS package consists of terrestrial microorganisms representing major metabolic pathways. A vital processes component of the BWS will examine the effects of a Mars sample at terrestrial atmospheric conditions while a hardy organism component will examine the effects of a Mars sample under conditions approaching those of the Martian environment. Any deleterious insult on terrestrial metabolism effected by the Mars sample could be indicated long before the sample reached earth proximity. Author

N78-21182# Army War Coll., Carlisle Barracks, Pa.
A TURNING POINT IN SPACE: HAS THE TIME ARRIVED FOR A NATIONAL REVIEW OF OUR SPACE POLICY
Richard L. Bowers, Donald B. Griggs, and Larry G. Hodge 13 May 1977 71 p refs
(AD-A049926) Avail: NTIS HC A04/MF A01 CSCL 22/1

The study investigates whether world conditions have changed to the extent that current policies which guide the national space effort may be in need of review. It examines, historically, how the space efforts of the United States and the Soviet Union have evolved. Primary emphasis is placed on the policy direction which has brought each of the national space programs up to the present. Technological factors have made a very significant impact upon the development of the space programs of both nations. Therefore, technological problems and opportunities are examined in detail. The study focuses on four fundamental issues which confront the national space effort as we enter the third decade in space. These issues are: (1) The overlap and convergence between civil and military programs. (2) The question of whether 'space for peaceful purposes' continues to remain a valid policy alternative. (3) How dependent have we become upon space. (4) Is space an arena where we have vital interests as a sovereign nation. The study conclusions are that we may have passed a significant turning point in space and, therefore, the time is overdue for a comprehensive review of our national space effort. GRA

N78-21183# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: PHYSICAL SCIENCES AND TECHNOLOGY, NO. 33
13 Apr. 1978 81 p Trans!. into ENGLISH from various Russian and French journals
(JPRS-70946) Avail: NTIS HC A05/MF A01

The use of computers in the Soviet construction industry is reported as well as activities at various observatories and the status of Ukrainian science. A description of the Salyut-6 space station as reported in Izvestia is included. For individual titles, see N78-21184 through N78-21185.

N78-21184# Joint Publications Research Service, Arlington, Va.
A RUNAWAY SATELLITE IS GOING TO CRASH 20 APRIL
Yves Dantin *In its* Transl. on USSR Sci. and Technol.: Phys. Sci. and Technol., No. 33 (JPRS-70946) 13 Apr. 1978 p 16-18 Transl. into ENGLISH from France-Soir (Paris), 26-27 Mar. 1978 p 1, 5 (For availability see N78-21183 12-12)
Avail: NTIS HC A05/MF A01

Despite Soviet announcements that the uncontrolled reentry of the Cosmos 849 satellite will occur on May 6, 1978, the Director of the German Bochum Space Observatory predicts the event will occur on April 20th somewhere between the lattitudes of 70 deg N and 70 deg S. The Pentagon indicated that the satellite, which weighs 900 pounds, (and not 2 tons as the West German spokesman thought) does not operate on nuclear power, and therefore does not present the same dangers as was the case when Cosmos 954 crashed in Canada. A.R.H.

N78-21185# Joint Publications Research Service, Arlington, Va.
LABORATORY IN SPACE
K. Feoktistov and G. Dolgopolov *In its* Transl. on USSR Sci. and Technol.: Phys. Sci. and Technol., No. 33 (JPRS-70946) 13 Apr. 1978 p 19-23 refs Transl. into ENGLISH from Izvestiya (Moscow), 18 Mar. 1978 p 1, 6 (For availability see N78-21183 12-12)
Avail: NTIS HC A05/MF A01

A multipurpose ampule electric furnace, an orbital submillimeter telescope, and a multizonal space camera were among the special purpose instruments transported by the Progress -1 freight ship to increase the technical potential of the Salyut -6 space station. The possibility of mooring two transport ships bringing new equipment, expendable materials, and spare parts enhances the effectiveness of the research equipment by permitting it to operate for longer periods of time in a wider range of work modes. The capabilities of the orbital complex for astrophysical, geophysical, biological, medical, and space processing research activities are summarized. A.R.H.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N78-21186# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ORBIT PREDICTION ERRORS RESULTING FROM VERTICAL MISALIGNMENT OF A RADAR ANTENNA
Aubyn Freed 15 Dec. 1977 35 p refs
(Contract F19628-78-C-0002)
(AD-A050161; TN-1977-43; ESD-TR-77-336) Avail: NTIS HC A03/MF A01 CSCL 17/9

Accidental misalignment of an antenna's vertical reference axis with respect to the local vertical introduces errors into the measurements of azimuth and elevation directly. If corresponding corrections are neglected, relatively small misalignments can prevent a radar from achieving high-accuracy orbit-determination. The use of electronic level-sensors for making such corrections in real-time is described. Some numerical examples are presented to illustrate the problem. Author (GRA)

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air)*.

No abstracts in this category.

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N78-21187 Cornell Univ., Ithaca, N. Y.
THE LONG-PERIOD MOTION OF GEOSYNCHRONOUS SATELLITES Ph.D. Thesis
David Louis Richardson 1977 169 p
Avail: Univ. Microfilms Order No. 78-02057

A theory was developed for the long period motion of an earth-orbiting 24-hour satellite using extended phase space canonical formalism. Nonsingular Poincare variables were utilized in the development of the Hamiltonian which included the effects of oblateness, equatorial ellipticity, and lunisolar perturbations. Small values of the orbital eccentricity and inclination were assumed. All perturbations were developed through second order in the small parameters and variables of the Poincare system. Lunar motion is described by the second-order approximation of the Hill-Brown lunar theory. Solar motion was assumed to be elliptical about the earth-moon barycenter. Resonance due to equatorial ellipticity was handled by the application of a Lie series solution to the ideal resonance problem. Dissert. Abstr.

N78-21188*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE PLASMA INTERACTION EXPERIMENT (PIX) DESCRIPTION AND TEST PROGRAM
Louis R. Ignaczak, Fred A. Haley, Edward J. Domino, David H. Culp, and Francis J. Shaker 1978 20 p Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; cosponsored by AIAA and DGLR
(NASA-TM-78863; E-9594) Avail: NTIS HC A02/MF A01 CSCL 22A

The plasma interaction experiment (PIX) is a battery powered preprogrammed auxiliary payload on the LANDSAT-C launch. This experiment is part of a larger program to investigate space plasma interactions with spacecraft surfaces and components. The varying plasma densities encountered during available telemetry coverage periods are deemed sufficient to determine first order interactions between the space plasma environment and the biased experimental surfaces. The specific objectives of the PIX flight experiment are to measure the plasma coupling current and the negative voltage breakdown characteristics of a solar array segment and a gold plated steel disk. Measurements will be made over a range of surface voltages up to plus or minus kilovolt. The orbital environment will provide a range of plasma densities. The experimental surfaces will be voltage biased in a preprogrammed step sequence to optimize the data returned for each plasma region and for the available telemetry coverage. Author

N78-21189*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE PROCESSING APPLICATIONS ROCKET PROJECT SPAR III Final Report
Fred Reeves Jan. 1978 167 p refs
(NASA-TM-78137; M-244) Avail: NTIS HC A08/MF A01 CSCL 22A

This document presented the engineering report and science payload 3 test report and summarized the experiment objectives, design/operational concepts, and final results of each of five scientific experiments conducted during the third Space Processing Applications Rocket (SPAR) flight flown by NASA in December 1976. The five individual SPAR experiments, covering a wide and varied range of scientific materials processing objectives, were entitled: Liquid Mixing, Interaction of Bubbles with Solidification Interfaces, Epitaxial Growth of Single Crystal Film, Containerless Processing of Beryllium, and Contact and Coalescence of Viscous Bodies. Author

N78-21190*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF REUSABLE INSULATION SYSTEMS FOR CRYOGENICALLY-TANKED EARTH-BASED SPACE VEHICLES
Irving E. Sumner and James R. Barber 1978 21 p refs Presented at 2d Thermophys. and Heat Transfer Conf., Palo Alto, Calif., 24-26 May 1978; cosponsored by AIAA and ASME
(NASA-TM-73668; E-9192) Avail: NTIS HC A02/MF A01 CSCL 22B

Three reusable insulation systems concepts were developed for use with cryogenic tanks of earth-based space vehicles. Two concepts utilized double-goldized Kapton (DGK) or double-aluminized Mylar (DAM) multilayer insulation (MLI), while the third utilized a hollow-glass-microsphere, loadbearing insulation (LBI). Thermal performance measurements were made under space-hold (vacuum) conditions for insulating warm boundary temperatures of approximately 291 K. The resulting effective thermal conductivity was approximately 0.00008 W/m-K (W = weight,Kg; m = measured; K = temperature) for the MLI systems (liquid hydrogen test results) and 0.00054 W/m-K for the LBI system (liquid nitrogen test results corrected to liquid hydrogen temperature). Author

N78-21191*# National Aeronautics and Space Administration, Washington, D. C.
HEAT CAPACITY MAPPING MISSION (HCMM) LAUNCH
19 Apr. 1978 30 p
(NASA-TM-79429; E-651-78-01) Avail: NTIS HC A03/MF A01 CSCL 22A

The heat capacity mapping mission (HCMM) supports exploratory scientific investigations using infrared remote sensor derived temperature measurements of the earth's surface within a 12-hour interval at times when the temperature variation is at a maximum to establish the feasibility of applying the day/night temperature difference measurements to the determination of thermal inertia. The HCMM spacecraft orbit was chosen to be synchronous with a nominal ascending equatorial crossing time of 2:00 p.m., in order to provide north middle latitude (40 degrees) crossing times of 1:30 p.m. and 2:30 a.m. at 12-hour intervals approximately every 5 days. Data will be acquired by a two channel scanning radiometer. One spectral channel covers the visible and near infrared band between 0.5 and 1.1 micrometers; the other channnel covers the thermal infrared band between 10.5 and 12.5 micrometers. From the nominal orbit altitude of 620 km, the spatial resolution of the visible and thermal infrared radiometer channels will be approximately 500 by 500 meters at nadir, and the ground swath of data coverage along the track will be 700 km wide. Author

N78-21192*# National Aeronautics and Space Administration, Washington, D. C.
BIOLOGICAL SATELLITE KOSMOS-936
L. A. Vedeshin Apr. 1978 8 p refs Translated into ENGLISH from Biologicheskiysputnik Kosmos-936, USSR, no. 11, Nov. 1977, p 147-148
(Contract NASw-2791)
(NASA-TM-75097) Avail: NTIS HC A02/MF A01 CSCL 22B

A description is given of physiological experiments performed on the biological satellite Kosmos-936. Other experiments to determine the electrostatic and dielectric responses to the effects of cosmic radiation are discussed. Author

N78-21193*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THEORETICAL CONTAMINATION OF CRYOGENIC SATELLITE TELESCOPES

M. Murakami (Tokyo Univ., Japan) Apr. 1978 49 p refs (NASA-TP-1177; A-7024) Avail: NTIS HC A03/MF A01 CSCL 22A

The state of contaminant molecules, the deposition rate on key surfaces, and the heat transfer rate were estimated by the use of a zeroth-order approximation. Optical surfaces of infrared telescopes cooled to about 20 K should be considered to be covered with at least several deposition layers of condensible molecules without any contamination controls. The effectiveness of the purge gas method of contamination controls was discussed. This method attempts to drive condensible molecules from the telescope tube by impacts with a purge gas in the telescope tube. For this technique to be sufficiently effective, the pressure of the purge gas must be more than 2 x .000001 torr. The influence caused by interactions of the purged gas with the particulate contaminants was found to slightly increase the resident times of the particulate contaminants within the telescope field of view. Author

N78-21194# Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics.
A SATELLITE CONTROL PROBLEM
Herman Chernoff and A. John Petkau 22 Dec. 1977 56 p refs
(Contract N00014-75-C-0555)
(AD-A049510; TR-9) Avail: NTIS HC A04/MF A01 CSCL 22/3

A numerical approach is described for calculating the optimal policy in the stochastic control problem of keeping a satellite close to a fixed point in space when it is subject to random forces. The random forces are modelled by Brownian Motion. A policy is evaluated in terms of its long run expected average cost. The running costs consist of a charge for fuel used plus a charge of x sub 1 squared per unit of time when the satellite is x sub 1 units away from the target. The space is one-dimensional. The method used is to apply backward induction to a bounded discrete space, discrete time version of the problem. Incidentally a solution is presented for the deterministic version of the problem where there are no random forces. GRA

N78-21195# Decisions and Designs, Inc., McLean, Va.
SATELLITE SURVEILLANCE AVOIDANCE OPTIMIZATION AID Final Report, 1 Mar. 1976 - 31 Dec. 1977
Scott Barclay and L. Scott Randall Dec. 1977 46 p refs
(Contract N00039-76-C-0279; ARPA Order 3175)
(AD-A049561; PR-77-14-36) Avail: NTIS HC A03/MF A01 CSCL 17/4

Recent technological advances have made possible sophisticated data-gathering capabilities for earth-orbiting spacecraft. Naval forces would appear to be particularly vulnerable to satellite surveillance since they operate on the surface of uniform, low-noise oceans where camouflaging is difficult. A methodology is presented for helping a naval commander avoid satellite surveillance. With known satellite orbital characteristics, the time and location of detection zones along a ship's planned route can be calculated. It is suggested that a commander can avoid many of these detection zones by varying his speed as a function of time. A graphical representation is presented and its limitations are discussed. A decision aid based on this methodology has been developed. It uses probabilistic information, such as weather, to find the expected number of detections for any speed profile. An optimal speed profile is found by means of dynamic programming. Author (GRA)

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

N78-21196*# Vought Corp., Mountain View, Calif.
SPACE SHUTTLE L-TUBE RADIATOR TESTING Final Report
M. A. Phillips 23 Dec. 1976 175 p
(Contract NAS9-10534)
(NASA-CR-151695; T169-67) Avail: NTIS HC A08/MF A01 CSCL 22B

A series of tests were conducted to support the development of the Orbiter Heat Rejection System. The details of the baseline radiator were defined by designing, fabricating, and testing representative hardware. The tests were performed in the Space Environmental Simulation Laboratory Chamber A. An IR source was used to simulate total solar and infrared environmental loads on the flowing shuttle radiators panel. The thermal and mechanical performance of L tube space radiators and their thermal coating were established. Author

N78-21197*# Martin Marietta Aerospace, Denver, Colo.
SHUTTLE ORBITER - IUS/DSP SATELLITE INTERFACE CONTAMINATION STUDY Final Report
R. O. Rantanen and D. A. Strange 21 Mar. 1978 57 p
(Contract NAS9-15335)
(NASA-CR-151682; MCR-78-512) Avail: NTIS HC A04/MF A01 CSCL 06M

The results of a contamination analysis on the Defense Support Program (DSP) satellite during launch and deployment by the Space Transportation System (STS) are presented. Predicted contaminant deposition was also included on critical DSP surfaces during the period soon after launch when the DSP is in the shuttle orbiter bay with the doors closed, the bay doors open, and during initial deployment. Additionally, a six sided box was placed at the spacecraft position to obtain directional contaminant flux information for a general payload while in the bay and during deployment. The analysis included contamination sources from the shuttle orbiter, IUS and cradle, the DSP sensor and the DSP support package. Author

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N78-21198*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SIMPLIFIED MODEL OF STATISTICALLY STATIONARY SPACECRAFT ROTATION AND ASSOCIATED INDUCED GRAVITY ENVIRONMENTS
George H. Fichtl and Robert L. Holland Feb. 1978 43 p refs
(NASA-TM-78164) Avail: NTIS HC A03/MF A01 CSCL 22B

A stochastic model of spacecraft motion was developed based on the assumption that the net torque vector due to crew activity and rocket thruster firings is a statistically stationary Gaussian vector process. The process had zero ensemble mean value, and the components of the torque vector were mutually stochastically independent. The linearized rigid-body equations of motion were used to derive the autospectral density functions of the components of the spacecraft rotation vector. The cross-spectral density functions of the components of the rotation vector vanish for all frequencies so that the components of rotation

were mutually stochastically independent. The autospectral and cross-spectral density functions of the induced gravity environment imparted to scientific apparatus rigidly attached to the spacecraft were calculated from the rotation rate spectral density functions via linearized inertial frame to body-fixed principal axis frame transformation formulae. The induced gravity process was a Gaussian one with zero mean value. Transformation formulae were used to rotate the principal axis body-fixed frame to which the rotation rate and induced gravity vector were referred to a body-fixed frame in which the components of the induced gravity vector were stochastically independent. Rice's theory of exceedances was used to calculate expected exceedance rates of the components of the rotation and induced gravity vector processes. Author

N78-21199*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHARGING OF FLEXIBLE SOLAR ARRAY SUBSTRATES IN KILOVOLT ELECTRON BEAMS
John V. Staskus and Steven J. Narciso Mar. 1978 32 p refs (NASA-TM-73865; E-9455) Avail: NTIS HC A03/MF A01 CSCL 10A

A series of survey tests were conducted to evaluate samples of flexible solar arrays. The samples used woven carbon fibers and/or coatings to increase the surface conductivity of the KAPTON substrate and thereby reduce surface charging. Four different samples were evaluated by exposing them to monoenergetic electron beams of 2 to 20 KeV at a current density of 1 nA sq cm. Simulated eclipse tests were also conducted. The results were as expected; the more continuous the conductive pattern, the lower the surface charging. Author

N78-21200*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE N-BOD2 USER'S AND PROGRAMMER'S MANUAL
Harold P. Frisch Feb. 1978 307 p refs
(NASA-TP-1145; G-7702-F22) Avail: NTIS HC A14/MF A01 CSCL 22B

A general purpose digital computer program was developed and designed to aid in the analysis of spacecraft attitude dynamics. The program provides the analyst with the capability of automatically deriving and numerically solving the equations of motion of any system that can be modeled as a topological tree of coupled rigid bodies, flexible bodies, point masses, and symmetrical momentum wheels. Two modes of output are available. The composite system equations of motion may be outputted on a line printer in a symbolic form that may be easily translated into common vector-dyadic notation, or the composite system equations of motion may be solved numerically and any desirable set of system state variables outputted as a function of time. Author

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N78-21201# Los Alamos Scientific Lab., N. Mex.
EFFECT OF ATTITUDE CONTROL THRUSTER INDUCED STRUCTURAL VIBRATIONS ON SENSED ACCELERATIONS OF A SPACE VEHICLE
T. A. Butler Sep. 1977 41 p ref Sponsored in part by the Navy
(Contract W-7405-eng-36)
(LA-6965-MS) Avail: NTIS HC A03/MF A01

The response of a miniature electrostatic accelerometer (MESA) to the structural vibrations of a space vehicle (SV) is determined analytically. Knowledge of these vibration-induced accelerations will be used to interpret the total MESA accelerations that will be obtained while the SV is in orbit. Equations of motion containing nonlinear terms are solved to show that a linear analysis approach will yield sufficient accuracy. A Laplace transform technique is then used to solve the linearized equations, which are decoupled using the normal vibration modes of the SV. A computer program is developed to solve the equations of motion. It includes frequency attenuation and sampling interval characteristics of the MESA and equivalent viscous damping for the SV vibratory modes. The calculated MESA response to 1800's of actual thruster excitation is presented. The calculated results show that the MESA electronic filter effectively eliminates accelerations from high frequency SV motion. ERA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N78-21202*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVOLUTION OF THE 1-mlb MERCURY ION THRUSTER SUBSYSTEM
W. R. Kerslake and B. A. Banks 1978 25 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; cosponsored by AIAA and DGLR
(NASA-TM-73733; E-9278) Avail: NTIS HC A02/MF A01 CSCL 21C

The developmental history, performance, and major lifetests of each component of the present 1-mlb (4.5 mN) thruster system are traced over the past 10 years. The 1-mlb thruster subsystem consists of an 8 cm diameter ion thruster mounted on 2 axis gimbals, a mercury propellant tank, a power electronics unit, a controller/digital interface unit, and necessary electrical harnesses plus propellant tankage and feed lines. Author

N78-21203*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PULSE IGNITION CHARACTERIZATION OF MERCURY ION THRUSTER HOLLOW CATHODE USING AN IMPROVED PULSE IGNITOR
E. G. Wintucky and R. P. Gruber 1978 20 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; cosponsored by AIAA and DGLR
(NASA-TM-78858; E-9592) Avail: NTIS HC A02/MF A01 CSCL 21C

An investigation of the high voltage pulse ignition characteristics of the 8 cm mercury ion thruster neutralizer cathode identified a low rate of voltage rise and long pulse duration as desirable factors for reliable cathode starting. Cathode starting breakdown voltages were measured over a range of mercury flow rates and tip heater powers for pulses with five different rates of voltage rise. Breakdown voltage requirements for the fastest rising pulse (2.5 to 3.0 kV/micro sec) were substantially higher (2 kV or more) than for the slowest rising pulse (0.3 to 0.5 kV/micro sec) for the same starting conditions. Also described is an improved, low impedance pulse ignitor circuit which reduces power losses and eliminates problems with control and packaging associated with earlier designs. Author

N78-21204*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PLANNED FLIGHT TEST OF A MERCURY ION AUXILIARY PROPULSION SYSTEM. 1: OBJECTIVES, SYSTEMS DESCRIPTIONS, AND MISSION OPERATIONS
John C. Power 1978 46 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; cosponsored by AIAA and DGLR
(NASA-TM-78859; E-9589) Avail: NTIS HC A03/MF A01 CSCL 21C

A planned flight test of an 8 cm diameter, electron-bombardment mercury ion thruster system is described. The primary objective of the test is to flight qualify the 5 mN (1 mlb.) thruster system for auxiliary propulsion applications. A seven year north-south stationkeeping mission was selected as the basis for the flight test operating profile. The flight test, which will employ two thruster systems, will also generate thruster system

space performance data, measure thruster-spacecraft interactions, and demonstrate thruster operation in a number of operating modes. The flight test is designated as SAMSO-601 and will be flown aboard the shuttle-launched Air Force space test program P80-1 satellite in 1981. The spacecraft will be 3- axis stabilized in its final 740 km circular orbit, which will have an inclination of approximately greater than 73 degrees. The spacecraft design lifetime is three years. Author

N78-21205*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF FACILITY BACKGROUND GASES ON INTERNAL EROSION OF THE 30-cm Hg ION THRUSTER
Vincent K. Rawlin and Maris A. Mantenieks 1978 31 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; sponsored by AIAA and DGLR
(NASA-TM-73803; E-9584; AIAA-78-665) Avail: NTIS HC A03/MF A01 CSCL 21C

Sputtering erosion of the upstream side of the molybdenum screen grid by discharge chamber ions in mercury bombardment thrusters was considered. Data which revealed that the screen grid erosion was very sensitive to the partial pressure of certain background gases in the space simulation vacuum facility were presented along with results of tests conducted to evaluate this effect. It is shown from estimates of the screen grid erosion in space that adequate lifetime for proposed missions exists. Author

N78-21206*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REVIEW OF ELECTRON BOMBARDMENT THRUSTER SYSTEMS/SPACECRAFT FIELD AND PARTICLE INTERFACES
David C. Byers 1978 36 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; sponsored by AIAA and DGLR
(NASA-TM-78850; E-9571) Avail: NTIS HC A03/MF A01 CSCL 21C

Information on the field and particle interfaces of electron bombardment ion thruster systems was summarized. Major areas discussed were the nonpropellant particles, neutral propellant, ion beam, low energy plasma, and fields. Spacecraft functions and subsystems reviewed were solar arrays, thermal control systems, optical sensors, communications, science, structures and materials, and potential control. Author

N78-21207*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DIAGNOSTIC EVALUATIONS OF A BEAM-SHIELDED 8-cm MERCURY ION THRUSTER
S. Nakanishi 1978 25 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; sponsored by AIAA and DGLR
(NASA-TM-78855; E-9581) Avail: NTIS HC A02/MF A01 CSCL 21C

An engineering model thruster fitted with a remotely actuated graphite fiber polyimide composite beam shield was tested in a 3- by 6.5-meter vacuum facility for in situ assessment of beam shield effects on thruster performance. Accelerator drain current neutralizer floating potential and ion beam floating potential increased slightly when the shield was moved into position. A target exposed to the low density regions of the ion beam was used to map the boundaries of energetic fringe ions capable of sputtering. The particle efflux was evaluated by measurement of film deposits on cold, heated, bare, and enclosed glass slides. Author

N78-21208*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE 5200 CYCLE TEST OF AN 8-cm DIAMETER Hg ION THRUSTER
M. A. Mantenieks and E. G. Wintucky 1978 27 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; sponsored by AIAA and DGLR
(NASA-TM-78860; E-9590) Avail: NTIS HC A03/MF A01 CSCL 21C

An accelerated cycle test was conducted in which an 8-cm Engineering Model Thruster (EMT) prototype successfully completed 5200 on-off cycles and a total of more than 1300 hours of thruster operation at a 4.5 mN thrust level. Cathode tip heater powers required for starting and keeper voltages remained well within acceptable limits. The discharge chamber utilization and electrical efficiency were nearly constant over the duration of the test. It was concluded that on-off cyclic operation by itself does not appreciably degrade starting capability or performance of the 8-cm EMT. Author

N78-21209*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PLANNED FLIGHT TEST OF A MERCURY ION AUXILIARY PROPULSION SYSTEM. PART 2: INTEGRATION WITH HOST SPACECRAFT
Rodney M. Knight 1978 16 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; sponsored by AIAA and DGLR
(NASA-TM-78869; E-9599) Avail: NTIS HC A02/MF A01 CSCL 21C

The objectives of the flight test and a description on how those objectives are in support of an overall program goal of attaining user application were described. The approach to accomplishment was presented as it applies to integrating the propulsion system with the host spacecraft. A number of known interface design considerations which affect the propulsion system and the spacecraft were discussed. Analogies were drawn comparing the relationship of the organizations involved with this flight test with those anticipated for future operational missions. The paper also expanded upon objectives, system description, mission operations, and measurement of plume effects. Author

N78-21210*# Remtech, Inc., Huntsville, Ala.
PRETEST INFORMATION FOR A TEST TO VALIDATE PLUME SIMULATION PROCEDURES (FA-17) Final Report
Leroy M. Hair Jan. 1978 59 p refs
(Contract NAS8-32128)
(NASA-CR-150638; RM-024-1) Avail: NTIS HC A04/MF A01 CSCL 21H

The results of an effort to plan a final verification wind tunnel test to validate the recommended correlation parameters and application techniques were presented. The test planning effort was complete except for test site finalization and the associated coordination. Two suitable test sites were identified. Desired test conditions were shown. Subsequent sections of this report present the selected model and test site, instrumentation of this model, planned test operations, and some concluding remarks. Author

N78-21211*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID ROCKET ENGINE SELF-COOLED COMBUSTION CHAMBERS Space Vehicle Design Criteria
Sep. 1977 130 p refs
(NASA-SP-8124) Avail: NTIS HC A07/MF A01 CSCL 21H

Self-cooled combustion chambers are chambers in which the chamber wall temperature is controlled by methods other than fluid flow within the chamber wall supplied from an external source. In such chambers, adiabatic wall temperature may be controlled by use of upstream fluid components such as the injector or a film-coolant ring, or by internal flow of self-contained materials; e.g. pyrolysis gas flow in charring ablators, and the flow of infiltrated liquid metals in porous matrices. Five types of self-cooled chambers are considered in this monograph. The name identifying the chamber is indicative of the method (mechanism) by which the chamber is cooled, as follows: ablative; radiation cooled; internally regenerative (Interegen); heat sink; adiabatic wall. Except for the Interegen and heat sink concepts, each chamber type is discussed separately. A separate and final section of the monograph deals with heat transfer to the chamber wall and treats Stanton number evaluation, film cooling, and film-coolant injection techniques, since these subjects are common to all chamber types. Techniques for analysis of gas film cooling and liquid film cooling are presented. Author

N78-21212*# National Aeronautics and Space Administration, Washington, D. C.
MATHEMATICAL SIMULATION OF POWER CONDITIONING SYSTEMS. VOLUME 1: SIMULATION OF ELEMEN-

TARY UNITS. REPORT ON SIMULATION METHODOLOGY Final Report
R. Prajous, J. Mazankine, and J. C. Ippolito Apr. 1978 95 p refs Transl. into ENGLISH of "Simulation Mathematique des Systemes de Conditionnement de Puissance. Simulation des Unites Elementaires. Rapport sur la Methodologie de Simulation" CNRS Rept. LAAS-Publ-145-3-Vol-1, and ESA-CR-(P)-949-Vol-1, 20 Jul. 1976 97 p Original language document was announced as N77-32235 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Centre National de la Recherche Scientifique, Toulouse (France)
(Contract NASw-2790)
(NASA-TM-75209) Avail: NTIS HC A05/MF A01 CSCL 09C

Methods and algorithms used for the simulation of elementary power conditioning units buck, boost, and buck-boost, as well as shunt PWM are described. Definitions are given of similar converters and reduced parameters. The various parts of the simulation to be carried out are dealt with; local stability, corrective network, measurements of input-output impedance and global stability. A simulation example is given. Author

N78-21213# General Applied Science Labs., Inc., Westbury, N. Y.
UNSTEADY PLUME AND BLAST FIELD GENERATED BY A ROCKET LAUNCH Final Report, 15 Jan. 1976 - 14 Apr. 1977
John I. Erdos Sep. 1977 92 p refs
(Contract F44620-76-C-0058)
(AD-A050000; GASL-TR-246; AFOSR-77-1302TR) Avail: NTIS HC A05/MF A01 CSCL 20/4

The basic fluid dynamic properties of the unsteady plume and blast field generated by ignition and launch of a rocket have been defined for the inviscid flowfield, both in terms of numerical and asymptotic solutions, subject to the assumption of spherical symmetry. The key role of the energy deposition rate in determining the boundary conditions controlling the subject problem has been discussed, as well as the general behavior of the principal structural features of the flowfield, i.e., the blast wave, contact surface plume Mach disc. The effects of turbulent mixing in the steady exhaust stream of the rocket (prior to ground impingement) on the rate and duration energy disposition at the ground surface have been shown to be dominant for low acceleration rates, but negligible for very high acceleration rates; the net effect appears to desensitize the dependence of energy deposition on vehicle acceleration in the range of intermediate rates. Numerical examples are presented to illustrate the temperature, pressure and thermochemical characteristics of the unsteady flow region between the blast wave and Mach disc. The extreme temperature jump which persists across the contact surface has been emphasized as a possible cause of instability of this surface and a driving mechanism for production of turbulence (in the absence of a velocity jump across the contact surface). An unsteady turbulent mixing layer analysis has been formulated to describe conduction and diffusion across the contact surface. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N78-21214*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FIRE RESISTIVITY AND TOXICITY STUDIES OF CANDIDATE AIRCRAFT PASSENGER SEAT MATERIALS
L. L. Fewell, Ed Trabold (McDonnell Douglas Corp., Long Beach, Calif.), and H. Spieth (McDonnell Douglas Corp., Long Beach, Calif.) Mar. 1978 44 p refs
(NASA-TM-78468; A-7334) Avail: NTIS HC A03/MF A01 CSCL 21B

Fire resistivity studies were conducted on a wide range of candidate nonmetallic materials being considered for the construction of improved fire resistant aircraft passenger seats. These materials were evaluated on the basis of FAA airworthiness burn and smoke generation tests, colorfastness, limiting oxygen index, and animal toxicity tests. Physical, mechanical, and aesthetic properties were also assessed. Candidate seat materials that have significantly improved thermal response to various thermal loads corresponding to reasonable fire threats as they relate to in-flight fire situations, are identified. Author

N78-21215*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CALCULATED RATE CONSTANTS FOR THE REACTION ClO + O YIELDS Cl + O2 BETWEEN 220 AND 1000 DEG K
Richard L. Jaffee Apr. 1978 69 p refs Submitted for publication
(NASA-TM-78483; A-6613) Avail: NTIS HC A04/MF A01 CSCL 07D

Classical trajectory calculations are presented for the reaction ClO + O yields Cl + O2, a reaction which is an important step in the chlorine-catalyzed destruction of ozone which is thought to occur in the 220 and 1000 K. The calculated rate constant is 4.36 x 10 to the minus 11th power exp (-191/T)cu cm molecule (-1)s(-1) and its value at 300 K is 2.3 plus or minus 10 to the 11th power cu cm molecule (-1)s(-1), about a factor of 2 lower than recent experimental data. The empirical potential energy surface used in the calculations was constructed to fit experimental data for ClO, O2 and ClOO molecules. Other important features of this potential surface, such as the barrier to reaction, were varied systematically and calculations were performed for a range of conditions to determine the best theoretical rate constants. Results demonstrate the utility of classical trajectory methods for determining activation energies and other kinetic data for important atmospheric reactions.
Author

N78-21216*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FORMULATION OF ELECTRICALLY CONDUCTIVE THERMAL-CONTROL COATINGS
Michael C. Shai Apr. 1978 19 p refs
(NASA-TP-1218; G-97802-F9) Avail: NTIS HC A02/MF A01 CSCL 11D

The development and formulation of electrically conductive thermal control coating was undertaken for use on the International Sun Earth Explorer spacecraft. The primary effort was to develop a coating with a bulk resistivity of less than 100,000 ohm/sq m, an optical absorptance of approximately 0.55, and a normal emittance of 0.90. The required stability in space called for a bulk resistivity of less than 100,000 ohm/sq m, an absorptance of less than 0.67, and a normal emittance of 0.90 after exposure to approximately 4 x 10 to the 16th proton/sq cm of solar-wind particles and 5300 equivalent sun-hours. These exposures represent 2 years of ISEE flight conditions. Both the unsuccessful formulation efforts and the successful use of oxide pigments fired at 1448 K are described. Problems relative to the reactivity of specific coating vehicles exposed to high humidity are discussed. Author

N78-21217# Oak Ridge Y-12 Plant, Tenn.
MATERIALS FOR HIGH-TEMPERATURE HYDROGEN-FLUORINE ENVIRONMENTS
C. E. Holcombe, L. Kovach, and G. W. Weber 3 Oct. 1977 93 p refs Sponsored in part by AFWL
(Contract W-7405-eng-26)
(Y/DA-7477) Avail: NTIS HC A05/MF A01

The design, construction, and operation of a facility for the testing of materials under a hydrogen-fluorine torch were discussed. Tested materials were candidates for use as uncooled nozzles for a hydrogen-fluorine laser system currently being developed by the Air Force Weapons Laboratory. The behavior of 40 different compounds, solid solutions, and elements has been evaluated in the HF materials test facility including nine varieties of carbon. Data from 106 runs on these materials are reported. Observations, measurements, and test conditions are summarized. ERA

N78-21218# Oak Ridge National Lab., Tenn.
THERMOPHYSICAL PROPERTIES AND BEHAVIORAL CHARACTERISTICS OF PHASE-CHANGE MATERIALS
Stanley Cantor 1977 10 p refs Presented at ERDA-Inform.

Exchange Meeting for Thermal Energy Storage Program, Gatlinburg, Tenn., 29 Sep. 1977
(Contract W-7405-eng-26)
(CONF-770955-2) Avail: NTIS HC A02/MF A01

The primary and near-term objective of the project was to compile a handbook of compounds and mixtures that melt in the range of 90 to 250 C and which were suitable for isothermal heat storage. Organic compounds were screened according to bulk price, thermal stability, and safety. Compounds were selected for further consideration if they costed less than $1.10/kg and if encyclopedia articles or handbooks indicated that they were reasonably stable chemically and were not toxic or otherwise hazardous. Of seven compounds thus selected, four (urea, phthalimide, adipic acid, phthalic anhydride) were examined by DSC and other methods. The differential scanning calorimeter was used with two fairly well-characterized PCM's to test its applicability for rapidly evaluating thermal decomposition and supercooling. ERA

24 COMPOSITE MATERIALS

Includes laminates.

N78-21219*# Materials Sciences Corp., Blue Bell, Pa.
EVALUATION AND EXPANSION OF AN ANALYTICAL MODEL FOR FATIGUE OF NOTCHED COMPOSITE LAMINATES
R. L. Ramkumar, S. V. Kulkarni, and R. B. Pipes Mar. 1978 129 p refs
(Contract NAS1-13931)
(NASA-CR-145308; MSC/TFR/806/1025) Avail: NTIS HC A07/MF A01 CSCL 11D

The analytical and experimental study performed to expand the existing static and fatigue failure analysis is described. The analytical effort extended the analysis to include interlaminar effects, while the experimental effort developed methods to obtain basic experimental data required as input to the analysis. The static failure analysis for notched laminates was modified to include interlaminar effects near the notch. Three dimensional elastic and two dimensional elasticplastic finite element analysis were performed for some notched laminates. Author

N78-21220*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IN SITU PLY STRENGTH: AN INITIAL ASSESSMENT
C. C. Chamis and T. L. Sullivan 1978 19 p refs Presented at the 5th Conf. on Composite Mater.: Testing and design, New Orleans, 20-22 Mar. 1978; sponsored by Am. Soc. for Testing and Mater.
(NASA-TM-73771; E-9238) Avail: NTIS HC A02/MF A01 CSCL 11D

The in situ ply strengths in several composites were calculated using laminate fracture data for appropriate low modulus, and high modulus fiber composites were used in conjunction with the least squares method. The laminate fracture data were obtained from tests on Modmor-I graphite/epoxy, AS-graphite/epoxy, boron/epoxy and E-glass/epoxy. The results show that the calculated in situ ply strengths can be considerably different from those measured in unidirectional composites, especially the transverse strengths and those in angleplied laminates with transply cracks. Author

N78-21221*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TITANIUM/BERYLLIUM LAMINATES: FABRICATION, MECHANICAL PROPERTIES, AND POTENTIAL AEROSPACE APPLICATIONS
C. C. Chamis and R. F. Lark May 1978 25 p refs Presented at the 23d Natl. SAMPE Symp. and Exhibition, Anaheim, Calif., 2-4 May 1978
(NASA-TM-73891; E-9508) Avail: NTIS HC A02/MF A01 CSCL 11D

The investigation indicated that structural laminates can be made which have: a modulus of elasticity comparable to steel, fracture strength comparable to the yield strength of titanium, density comparable to aluminum, impact resistance comparable to titanium, and little or no notch sensitivity. These laminates can have stiffness and weight advantages over other materials including advanced fiber composites, in some aerospace applications where buckling resistance, vibration frequencies, and weight considerations control the design. Author

N78-21222# Lockheed Missiles and Space Co., Palo Alto, Calif.
COMPLEX LOADING OF A COMPOSITE MATERIAL WITH A PLASTIC MATRIX BY TORSION AND TENSION
A. F. Kreger and G. A. Teters [1977] 4 p refs Transl. into ENGLISH from Mekhan. Polimerov (USSR), no. 5, 1977 p 922-924 Presented at the 3d All-Union Conf. on Mech. of Polymers, Riga, 1976
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The deformation of a unidirectionally bonded metal composite under complex loading by torsion and tension is solved by using the theory of local strain and simplified hypotheses about the joint operation of the armature and the matrix. Author

N78-21223*# Douglas Aircraft Co., Inc., Long Beach, Calif.
AIRCRAFT CARGO COMPARTMENT FIRE TEST SIMULATION PROGRAM Final Report, Oct. 1974 - Jan. 1977
R. E. Blumke Jan. 1977 84 p refs
(Contract NAS2-8699)
(NASA-CR-151951; MDC-J7471) Avail: NTIS HC A05/MF A01 CSCL 11D

The objective of the test was to assess fire containment and fire extinguishment in the cargo by reducing the ventilation through the cargo compartment. Parameters which were measured included ignition time, burnthrough time, and physical damage to the cargo liner, composition of selected combustible gases, temperature-time histories, heat flux, and detector response. The ignitor load was made of a typical cargo consisting of filled cardboard cartons occupying 50% of the compartment volume. Author

N78-21224# Mississippi State Univ., Mississippi State. Dept. of Mechanical Engineering.
MIXED-MODE FRACTURE OF GRAPHITE/EPOXY COMPOSITES Final Technical Report, 1 Jun. 1976 - 1 Sep. 1977
Don H. Morris Nov. 1977 32 p refs
(Grant AF-AFOSR-3058-76)
(AD-A049528; AFOSR-78-0031TR) Avail: NTIS HC A03/MF A01 CSCL 11/4

The reported research presents results on the fracture strength of graphite/epoxy (T300/5208) (0/+ or - 45) and (0/+ or - 45/90) symmetric laminates in the presence of angle cracks. The results indicate that the fracture strength can be predicted irrespective of the crack orientation if one uses the effective normal crack length in the equation developed for normal cracks. The fracture strength prediction is made using a two parameter (unnotched fracture strength and inferred dimensions of the damage zone) model, when the laminate is subjected to uniaxial loading along one of the material symmetry axes. The results indicate that the critical damage zone is not constant for the two laminates although it is independent of the crack orientation. Author (GRA)

N78-21225# Southwest Research Inst., San Antonio, Tex.
STUDY OF ENVIRONMENTAL EFFECTS ON THERMOMECHANICAL BEHAVIOR OF RESIN-BASE COMPOSITES Final Scientific Report, May 1976 - Sep. 1977
T. S. Cook and D. E. Walrath Nov. 1977 132 p refs
(Contract F44620-76-C-0093; AF Proj. 2307; AF Proj. 9782)
(AD-A049538; AFOSR-77-1312TR) Avail: NTIS HC A07/MF A01 CSCL 11/4

A combined analytical and experimental study was designed to characterize moisture absorption in graphite/epoxy composite materials. Tests were designed to investigate the influence on moisture absorption of a number of composite parameters including thickness, fiber volume, and lay-up configuration. The environmental parameters investigated were the effects of temperature and humidity; the effect of small applied strains was also evaluated by use of four point bend specimens. The results were analyzed by comparing the weight gain characteristics of the various panels, and by evaluating the coefficients of diffusion

for the specimens. Based on these diffusivities, one and three dimensional solutions to Fick's equation were evaluated. A micromechanical model for laminates was developed and analyzed; the experimental data showed the model to be a lower bound solution. Moreover, the results indicate the classical solution to the one dimensional Fick's law based on effective diffusivity can be used to predict weight gain of a graphite/epoxy panel due to the presence of water. This model cannot currently predict secondary diffusion effects. The results of the bending tests showed no effect of small applied strains on the weight gain of the bend specimens. Author (GRA)

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics*.

N78-21226 Massachusetts Univ., Amherst.
X-RAY DIFFRACTION STUDIES OF HELIUM FOUR Ph.D. Thesis
Barry Louis Weiss 1977 173 p
Avail: Univ. Microfilms Order No. 77-30577

Experiments were performed to measure the density dependence of the structure factor of liquid and gaseous helium as a function of the density at constant temperature. The results demonstrate the gradual reduction in the size of the structure factor peak with decreasing density at a given temperature as well as a shift of the peak location to smaller values of the momentum transfer. The intercept as extrapolated from the observed structure factor is found to closely agree with that obtained from calculating the k = 0 value from the speed of sound, the ratio of the specific heats, and the temperature. Dissert. Abstr.

N78-21227 Wisconsin Univ., Madison.
TIME- AND SPACE-RESOLVED SPECIES DETERMINATION IN DIESEL COMBUSTION USING CONTINUOUS FLOW GAS SAMPLING Ph.D. Thesis
Kyung Tai Rhee 1977 304 p
Avail: Univ. Microfilms Order No. 77-23733

Concentrations of the major combustion species (CO2, CO, O2 and NOx), hydrocarbons(HCs) were measured as well as local fuel/air ratio in an operating open chamber type diesel engine cylinder during the reaction period. These data were obtained from several sampling positions in one of eight similar sprays in the combustion chamber so that both time- and space-resolved (T-S-R) species data were inferred. A rapid acting continuous flow type gas sampling system was developed. This system allowed a continuous flow of cylinder gases to pass thru the sampling valve orifice and upon demand diverted a small portion of this flow to a sample collection volume. Flow diversion was accomplished by action of an oscillating sampling tube. The minimum sampling period was approximately 0.5 msec and the portion of the sampling probe in the cylinder was 1/4 inch in diameter. Dissert. Abstr.

N78-21228 Illinois Univ., Urbana-Champaign.
A FULLY AUTOMATED SYSTEM FOR PULSED NMR MEASUREMENTS Ph.D. Thesis
David Milton Cantor 1977 147 p
Avail: Univ. Microfilms Order No. 78-03951

The development of an automated system for pulsed nuclear magnetic resonance (NMR) measurements is described. The system places many of the complex and tedious operations for several important pulsed NMR experiments under computer control. A brief discussion of the basic concepts in pulsed NMR experiments is presented and details of the hardware interface between the computer and the NMR instrument are described. Design features, justification of the choices made between the many alternative design strategies, and details of the implementation of design goals were given. Certain software features, common to all of the available experiments, were also studied. Dissert. Abstr.

N78-21229 Purdue Univ., Lafayette, Ind.
STUDIES OF FLASH-INDUCED PHOTOELECTROCHEMICAL PROCESSES Ph.D. Thesis
Betty Sue Shannon Hall 1977 106 p
Avail: Univ. Microfilms Order No. 78-03189

A photoelectrochemical technique was applied to the study of the photoreduction of Co(NH3)6(3+) in the presence of benzophenone. Currents due to the oxidation of benzophenone ketyl radical and the reduction of the Co(3) complex were monitored after flash irradiation. In basic alcoholic solution the initial amount of ketyl radical produced by the flash was significantly diminished in the presence of Co(3) complex. Also, the amount of Co(3) complex seen after the flash was lowered substantially in the presence of benzophenone. The reactivity of Co(3) and ketyl radical when both are present after a flash appears negligible, failing to account for the significant photoreduction observed immediately after the flash. These data suggest that the primary reaction pathway involves energy transfer from the excited benzophenone triplet to the Co(3) complex with subsequent decomposition to the Co(2) product. Dissert. Abstr.

N78-21230 Colorado State Univ., Fort Collins.
ANALYTICAL CAPABILITIES OF A DC PLASMA-ECHELLE SPECTROMETER SYSTEM Ph.D. Thesis
Isai T. Urasa 1977 234 p
Avail: Univ. Microfilms Order No. 7802400

The resolution characteristics of the system were determined by measurements of the instrument function using hollow cathode lamps as narrow line sources. Measurements of line widths emitted by the dc plasma indicated line broadening greater than that predicted by the Doppler equation. Two specific cases requiring high resolution were used to illustrate the capabilities of the unit. These included the isolation of iron and boron lines separated by 0.09 A and the determination of the atomic absorption profile of the mercury resonance line to be 0.085 A. The excitation characteristics of the plasma were also evaluated. The influence of plasma current on excitation was found to vary from element to element depending on the ionization potential and other chemical properties. It was shown however, that a plasma current of 7.5 amps was generally optimal. Dissert. Abstr.

N78-21231*# National Aeronautics and Space Administration, Washington, D. C.
ACTIVATION ANALYSIS OF ADMIXTURES IN CERTAIN SEMICONDUCTIVE MATERIALS
P. I. Artyukhin, E. P. Gilbert, and V. A. Pronin Apr. 1978 11 p refs Transl. into ENGLISH from Tr. Kom. Anal. Khim, Akad. Nauk SSSR, Inst. Geokhim. Anal. (USSR), v. 16, 1968 p 169-175 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75258) Avail: NTIS HC A02/MF A01 CSCL 07D

The use of extractions and chromatographic operations to separate macrobases, and to divide elements into groups convenient for gamma-spectrometric analysis is discussed. Methods are described for the activation detection of some impurities in silicon, arsenic, thallium, and trichloromethylsilane, on the basis of the extraction properties of bis(2-chlorethyl ether) and dimethylbenzylalkylammonium chloride. A schematic diagram of the extraction separation of elements-admixture is presented showing the aqueous and organic phases. The content percentage of the various elements are given in tables. A.R.H.

N78-21232*# National Aeronautics and Space Administration, Washington, D. C.
TEMPERATURE PROFILE OF GRAPHITE SURFACE BURNING IN A STREAM OF OXYGEN
D. Kisch Apr. 1978 12 p refs Transl. into ENGLISH from Bunsengesellschaft fuer Physik. Chem.-Ber. (West Germany), v. 71, no. 1, 1967 p 60-64 Transl. by Scientific Translation Service, Santa Barbara, Calif. Original Doc. Prep. by Muenster Univ., West Germany
(Contract NASw-2791)
(NASA-TM-75271) Avail: NTIS HC A02/MF A01 CSCL 21B

Using methods for the objective measurement of the spectrum

line reversal temperature in burning gases, the temperature profile at a graphite surface burning in a stream of oxygen was measured. From the behavior of the reversal temperature, it follows that particles in long-lived, high-energy states are present in the burning gas, and these bring about an overexcitation of the atomic species emitting the reversal line. Qualitative measurements show that a temperature maximum occurs at the expected distance of 1-2 mm from the graphite surface. Author

N78-21233# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.

THEORY OF TRACE ELEMENT DETECTION FROM A STATIC THERMAL INDUCTION PLASMA

Hans U. Eckert 31 Mar. 1978 53 p refs
(ATR-78(8209)-1) Avail: NTIS HC A04/MF A01

Emission spectroscopy of small samples sealed into high pressure electrodeless lamps greatly reduces the complexity of conditions commonly encountered in open excitation sources and facilities' theoretical treatment. Analytical curves and detection limits are calculated for such a closed system. A radio frequency (rf) induction discharge maintained in argon at atmospheric pressure in a cylindrical quartz vessel was considered as the excitation source. It is assumed that the plasma has a known temperature distribution, is in local thermal equilibrium and will undergo complete mixing with the vapors of trace elements. Charts and relationships are presented for convenient determination of the maximum number of atoms of an analytic element that the plasma can hold for a given container volume, minimum temperature at the plasma wall interface, and a suitably defined average plasma temperature. Author

N78-21234# National Bureau of Standards, Washington, D. C. Center for Fire Research.

TIME-DEPENDENT FIRE BEHAVIOR OF AIRCRAFT CABIN MATERIALS Final Report, Mar. 1976 - Jun. 1977

Clayton Huggett Dec. 1977 42 p refs
(Contract DOT-FA76WAI-610)
(AD-A050923; FAA-RD-77-99) Avail: NTIS HC A03/MF A01 CSCL 01/3

In an aircraft cabin or other inhabited compartment, the early stages of fire growth are critical to life safety. During this period the rate of fire growth, as measured by the mass fuel consumption rate, can be represented approximately as a simple exponential function of time. The rates of development of hazard from temperature rise and smoke and gas accumulation can be related to the mass fuel consumption rate. The growth constant k can be related to a small number of system parameters and fuel combustion properties. These properties were identified and laboratory methods for their measurement are suggested. In a fire situation, the critical hazard (temperature, smoke or gas) can be considered to be the one which first reaches a limiting human tolerance level. This mode can be identified and the effects of changes in design and materials on the rate of critical hazard development can be estimated. The simple exponential growth model may provide a means of predicting relative hazard with reasonable accuracy. Author

N78-21235*# Life Systems, Inc., Cleveland, Ohio.

ADVANCED SOLID ELECTROLYTE CELL FOR CO2 AND H2O ELECTROLYSIS Final Report

J. W. Shumar and T. A. Berger Mar. 1978 52 p refs
(Contract NAS2-7862)
(NASA-CR-152093; ER-190-25) Avail: NTIS HC A04/MF A01 CSCL 07D

A solid electrolyte cell with improved sealing characteristics was examined. A tube cell was designed, developed, fabricated, and tested. Design concepts incorporated in the tube cell to improve its sealing capability included minimizing the number of seals per cell and moving seals to lower temperature regions. The advanced tube cell design consists of one high temperature ceramic cement seal, one high temperature gasket seal, and three low temperature silicone elastomer seals. The two high temperature seals in the tube cell design represent a significant improvement over the ten high temperature precious metal seals required by the electrolyzer drum design. For the tube cell design the solid electrolyte was 8 mole percent yttria stabilized zirconium oxide slip cast into the shape of a tube with electrodes applied on the inside and outside surfaces. Author

N78-21236*# Columbia Univ., New York.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Final Progress Report, 1 Jul. 1976 - 31 Mar. 1977

William Happer 31 Mar. 1977 216 p refs
(Grant NGR-33-009-181; Contract DAAB07-74-C-0341; Grants AF-AFOSR-2685-74; DAAG29-77-G-0015; NSF DMR-73-07600; DA Proj. 1T1-61102-B-00R)
(NASA-CR-156069; AD-A049470; FPR-25) Avail: NTIS HC A10/MF A01 CSCL 07/4

A theoretical limit, (Omega squared)/(Omega)hfs, has been deduced for the exchange narrowed linewidth of magnetic resonance transitions in alkali vapors. Here omega is the Larmor frequency and (Omega)hfs is the hyperfine frequency of the atomic ground state. Experimentally measured linewidths do not approach this limit. The reason for the discrepancy is under investigation. Long range interactions were found to exist between self focused, spatially separated laser beams in alkali vapors. These forces were shown to be due to the exchange of spin-polarized atoms. A simple optically pumped device has been developed for visual, real-time display of contours of constant magnetic field in a region of inhomogeneous magnetic field. The same device can be used as an unconventional frequency spectrum analyzer for the radio frequency or microwave range. Both Cs2 and Rb2 molecules, when excited by certain lines of an Ar(-) laser, lead to the formation of alkali hydride crystals when hydrogen is mixed with the alkali vapor. No isotopic selectivity could be demonstrated in the case of laser excitation of Rb2. GRA

N78-21237# Naval Research Lab., Washington, D. C. Combustion and Fuels Branch.

THE USE OF HALONS AS FIRE SUPPRESSANTS: A LITERATURE SURVEY Interim Report

J. K. Musick and F. W. Williams 5 Oct. 1977 26 p refs
(AD-A050098; AD-E000079; NRL-8161) Avail: NTIS HC A03/MF A01 CSCL 13/2

The literature on the use of halons as fire suppressants is reviewed. Specific areas covered are: The decomposition of halons thermally and catalytically in fire situations; the effects of fire, halon concentration, and environmental factors such as temperature and humidity on corrosion rates; the corrosion effects of halons on diesel engines, sensitive instruments, electronic components, and computer materials. A bibliography on the toxicology of halons is included in the report. Author (GRA)

N78-21238# Rocketdyne, Canoga Park, Calif.

INORGANIC HALOGENOXIDIZER RESEARCH Annual Report, 1 Jan. - 31 Dec. 1977

K. O. Christe, C. J. Schack, W. W. Wilson, and R. D. Wilson 25 Jan. 1978 201 p refs
(Contract N00014-70-C-0294)
(AD-A050133; RI/RD78-125) Avail: NTIS HC A10/MF A01 CSCL 07/2

A simple method for the purification of fluorine is described. The formation of NF3(-) radical cation salts in the low-temperature uv-photolytic synthesis of NF4(-) salts was demonstrated by ESR spectroscopy. The mechanism of the NF4(-) salt formation is discussed. Metathetical NF4(-) salt processes based on NF4-BiF6 were studied. A previous literature claim for the synthesis of N2F5(-) salts is refuted. The novel N2F3(-) salts N2F3SnF5 and N2F3SbF6 were prepared and the planar structure of the N2F3(-) cation was established. The reaction chemistry of electropositive chlorine compounds with fluorocarbons was reviewed. The vibrational spectra and force fields of BrF3O, FBRO2, ClF4O(-), BrF4O(-), and IF4O(-) were determined. The novel oxonium salt, H3O(-) BiF6(-) was prepared and its properties were investigated. Three patents on the syntheses of ClF3O2, nitryl perchlorate, and anhydrous metal perchlorates were issued. GRA

N78-21239# National Bureau of Standards, Washington, D. C.

ULTRAVIOLET PHOTOEMISSION STUDIES OF FORMALDEHYDE AND RELATED MOLECULES ABSORBED ON RU(110) Interim Report

Galen B. Fisher, Theodore E. Madey, and John T. Yates, Jr. 15 Dec. 1977 25 p refs Submitted for publication
(Contract N00014-77-F-0008; RR0130801)

(AD-A049661; TR-9) Avail: NTIS HC A02/MF A01 CSCL 07/4

The adsorption of formaldehyde (H2CO), hydrogen, and carbon monoxide on Ru(110) has been studied using angle-integrated ultraviolet photoemission spectroscopy (UPS) and temperature programmed desorption (TPD). The UPS spectra for low exposures of H2CO at 80 K indicate that H2CO dissociates to a substantial degree. These spectra are compared with UPS spectra for the sequential adsorption of hydrogen and CO. Whereas there are similarities between these spectra, the differences in the UPS, work function change, and TPD results are sufficient to suggest that a portion of the dissociated H2CO may exist as a surface molecular complex containing H and CO. This is apparently the first reported example, based on a UPS study, of an oxygen-containing organic molecule which dissociates upon adsorption on a metal surface at 80 K. For high exposures at 80 K, adsorption of a condensed layer of molecular H2CO is observed.

Author (GRA)

N78-21240# Fluorochem, Inc., Azusa, Calif.

HIGH ENERGY HALOGEN CHEMISTRY Final Report, 1 Dec. 1976 - 31 Dec. 1977

Kurt Baum, Phillip T. Berkowitze, and Duane A. Lerdal Jan. 1978 52 p refs

(Contract N00014-71-C-0176; NR Proj. 093-052)

(AD-A049555) Avail: NTIS HC A04/MF A01 CSCL 07/3

Contents: Nitrosilicone Chemistry; Chemistry of 2-Fluoro-2-nitropropanediol; Experimental Bis(2-fluoro-2,2-dinitropropyl) silanediols; Reaction of bis(2-fluoro-2, 2-dinitropropyl) silanediol with chlorotrimethylsilane, Bis(3-3-fluoro-3,3-dinitropropyl) polysiloxane, Reaction of Bis(N-pyrrolidino-N'-phenylureido) dimethylsilane with Bis-2-fluoro-2,2-dinitropropyl)silanediol, 2-Fluoro-2-nitro-1,3-propanediol, 2-fluoro-3-hydroxy-2-nitro-1-propyl p-Toluenesulfonate, 2-Fluoro-2-nitro-1,3-propylene Di-ptoluenesulfonate, 2,6-difluoro-7-hydroxy 2,6-dinitro-4-oxa-1-heptyl p-Toluenesulfonate, 3-Azide-2-fluoro-2-nitro-1-propanol, 3-Bromo-2-fluoro-2-nitro-1-propanol, 1,3-diazido 2-fluoro-2-nitro-propane, 2-Fluoro-3-hydroxy-2-nitro-1-propyl Triflate, 2-Fluoro-2-nitro-1,3-propylene Ditriflate, 3-Fluoro-3-nitrooxetane, Reaction of 2-Fluoro-3-hydroxy-2-nitro-1-propyl Triflate with Pyridine, 3-Chloro-2-fluoro-2-nitro-1-propanol, Reaction of 2,2-Dinitro-1,3-propanediol with Triflic Anhydride; References; Appendices -- Synthesis of Organosilanes and Polysiloxanes with Nitro and Fluoro Substituents, Synthesis of Bis (3,3-dinitrobuty1) cyclopolysiloxanes; and Distribution List. GRA

N78-21241# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

EXPERIMENTS RELATED TO EXTERNAL BURNING FOR PROPULSION Final Report, Feb. 1977 - Sep. 1977

Warren C. Strahle, James E. Hubbartt, Douglas H. Neale, and Danny J. Huval Oct. 1977 23 p refs

(Grant AF-AFOSR-2794-75)

(AD-A047623; AFOSR-77-1291TR) Avail: NTIS HC A02/MF A01 CSCL 21/2

An experimental study of base flows for a 2.25 inch diameter projectile at Mach 3 with cold air injection is reported. Upstream radial jet injection and base injection are used. The work is a continuation of a systematic study of many of the flow field features of external burning. It is shown that radial jet injection alters the wake structure, shortens the wake, and reduces the base pressure. In addition, the advantage of base injection using porous base bleed diminishes with injection rate and external compression. Author (GRA)

N78-21242# Aerospace Corp., El Segundo, Calif.

EMISSION SPECTRUM OF THE NU3 BAND OF SF6 AT 1780K

Jerry F. Bott 20 Jan. 1978 14 p refs

(Contract F04701-77-C-0078)

(AD-A049865; TR-0078(3940-02)-2; SAMSO-TR-78-7) Avail: NTIS HC A02/MF A01 CSCL 07/4

The emission spectrum of the nu3 band of SF6 at 1780 K is measured in a shock tube. At this high temperature, the emission peaks at a frequency of 907/cm (11.02 mu); at room temperature, the band has a peak intensity at 948/cm. Lyman and Nowak observed similar but proportionately smaller shifts of the spectral maximum to lower frequencies at temperatures between 400 and 800 K. A knowledge of the high-temperature spectral distribution of the nu3 band is important for the design and interpretation of isotope separation experiments in which SF6 is dissociated by selective multiphoton absorption of CO2 laser photons. GRA

N78-21243# University of Southern Calif., Los Angeles. Dept. of Chemistry.

PHOTOCHEMICAL AND KINETIC STUDIES OF SOME METAL DITHIZONATE COMPLEXES

Christine Geosling, Arthur W. Adamson, and Adolfo Gutierrez Dec. 1977 34 p refs

(Contract N00014-76-C-0548; Grant NSF CHE-74-08535)

(AD-A049872; TR-2) Avail: NTIS HC A03/MF A01 CSCL 07/3

Metal dithizonates form an interesting class of photochromic complexes. The most definitive study in the literature is that of Meriwether and co-workers, who reported on the preparation, the spectra, the qualitative photochemistry, and the thermal return rates for various dithizonates. Author (GRA)

N78-21244# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

INVESTIGATION OF THE PROPERTIES OF THE COMBUSTION PRODUCTS GENERATED BY BUILDING FIRES Final Report, 1 Oct. 1976 - 30 Sep. 1977

B. T. Zinn, R. A. Cassanova, C. P. Bankstow, R. F. Brower, and E. A. Powell 1977 103 p

(Grant NBS-G7-9001)

(PB-276549/3; NBS-GCR-77-116) Avail: NTIS HC A06/MF A01 CSCL 21B

Eleven polyvinyl chloride and seven polypropylene samples of different compositions were burned under non-flaming conditions and measurements were made of smoke particle size distributions, total smoke particulate mass generated, smoke mean particle diameter, smoke optical density, and sample weight loss. Measurements were taken for the polypropylene samples burned in a heated ventilation gas. Results show that the characteristics of the smoke particulates and sample weight loss behavior were affected by the presence or absence of different chemical additives for both PVC and polypropylene. GRA

N78-21245# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.

FUNDAMENTAL AND SEMI-GLOBAL KINETIC MECHANISMS OF HYDROCARBON COMBUSTION Progress Report, 1 Mar. - 30 Sep. 1977

I. Glassman and F. L Dryer Sep. 1977 40 p refs

(Contract EC-77-S-02-4272)

(COO/4272-1) Avail: NTIS HC A03/MF A01

Major emphasis in combustion research is being given to the study of oxidation of hydrocarbon fuels to lend insight into the modelling of combustion processes. The introduction of combustion chemistry into the already complex turbulent flow situations which exist in practical devices make modelling exceptionally difficult. Semi-global reaction mechanisms offer the potential of reducing the overall chemical kinetic complexity, thus substantially reducing the computational barriers to appropriate modelling of combustion processes. Reported here are the results of efforts presently underway to provide a general understanding of hydrocarbon oxidation. Specifically, the results of studies of the lean oxidation of ethane along with the developed semi-global rates are reported. Initial results for the lean oxidation of propane are discussed and the present status of studies on methanol oxidation is also reported. ERA

N78-21246# Addis Translations International, Portola Valley, Calif.

MECHANISM OF THE DECOMPOSITION OF ETHYLENE AT LOW PRESSURE ON THE SURFACE OF RHENIUM RIBBON AT HIGH TEMPERATURE, 2

R. Ducros and P. LeGoff 1969 20 p refs Transl. into ENGLISH from Surface Sci. (Neth.), v. 14, 1969 p 197-208 Prepared for Battelle Pacific Northwest Labs., Richland, Wash.

(BNWL-TR-254) Avail: NTIS HC A02/MF A01

The decomposition of ethylene in molecular regime on rhenium ribbon is studied. As in the case of tungsten, this decomposition yields only hydrogen and carbon, part of which diffuses into the metal and part of which contaminates the surface. At the start

of each measurement, the collision efficiency b/sub a/ of ethylene decomposition is nearly unity; it then decreases because of contamination of the surface, and reaches values below the threshold of sensitivity of the apparatus. Carbon forms only a solid solution with rhenium. Using the general laws of diffusion, the variation of carbon concentration in the solid solution near the surface is studied and related to contamination of the surface. At high temperature, evaporation of carbon occurs because its vapor pressure is no longer negligible. ERA

N78-21247# University of Southern Calif., Los Angeles.
THERMOCHEMISTRY AND KINETICS OF SULFUR CONTAINING MOLECULES AND RADICALS Final Report
Sidney W. Benson Nov. 1977 58 p refs Sponsored by EPA
(PB-275721/9; EPA-600/3-77-127) Avail: NTIS
HC A04/MF A01 CSCL 07D

Kinetic steps in air pollution chemistry and combustion are examined. The thermochemistry of divalent, tetravalent, and hexavalent sulfur compounds, the relevant bond strengths of radicals, and the kinetics of oxidation processes are discussed. The entropy and heat of formation measured experimentally or estimated are presented for selected sulfur molecules and radicals. GRA

N78-21248# California State Dept. of Health, Berkeley. Air and Industrial Hygiene Lab.
COMPARISON OF WET CHEMICAL AND INSTRUMENTAL METHODS FOR MEASURING AIRBORNE SULFATE Final Report
B. R. Appel, E. L. Kothny, E. M. Hoffer, and J. J. Wesolowski Nov. 1977 180 p refs
(Contract EPA-68-02-2273)
(PB-276620/2; EPA-600/7-77-128) Avail: NTIS
HC A09/MF A01 CSCL 07D

The methylthymol blue modified Brosset, and barium chloranilate sulfate methods were evaluated for precision, accuracy, working range, interference effects, and degree of agreement with X-ray fluorescence analysis using atmospheric particulate samples. The samples used were collected simultaneously with glass fiber, quartz fiber and fluoropore filters, the latter being used in a dichotomous sampler. Studies of interference effects were based upon measured concentrations of potential interferents extractable from the particulate matter as well as the filter media. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N78-21249 Ohio State Univ., Columbus.
STUDIES OF TRANSITION METAL ANALOGS OF HEXABORANE (10). NUCLEAR MAGNETIC RESONANCE STUDIES OF HEPTABORANE SPECIES Ph.D. Thesis
James David Ragaini 1977 129 p
Avail: Univ. Microfilms Order No. 2831958

The compound B5H9Fe(CO)3 was prepared but characterization was limited to mass spectrometric studies. Nuclear magnetic resonance studies have shown that this ferraborane is stereochemically nonrigid in solution. Hydrogen migration between two iron-boron sites in the basal plane of the pentagonal pyramid was responsible for the dynamic character. Deprotonation of B5H9Fe(CO)3 was accomplished and the X-ray crystal structure determination of the tetra-n-butyl-ammonium salt indicated the presence of iron at a basal vertex position. Nuclear magnetic resonance studies of [B5H8Fe(CO)3] have shown that migration of bridge hydrogens among basal boron-boron sites occurs independently of the migration of hydrogen between iron-boron sites. Dissert. Abstr.

N78-21250 College of William and Mary, Williamsburg, Va.
THEORY OF AMORPHOUS CuNi ALLOYS Ph.D. Thesis
Kun-San Chang 1977 105 p
Avail: Univ. Microfilms Order No. 77-31804

A check of results of the Anderson and McMillan model for an amorphous (random liquid) metal and the modification of Schwartz and Ehrenreich show that both groups missed branches of the dispersion E(k) curve (band structure) around the region of the d-resonance energy. The method of calculating the density of states from the E(k) curve developed is generalized to the case where there are two values of k corresponding to the same energy. Numerical results for the density of states and the Fermi energy are presented for amorphous Cu and Ni. The dispersion curves can be interpreted in terms of an s-d hybridization model similar to that used for solid transition metals. This model is then extended to calculate the dispersion relations and the density of states of amorphous binary alloys. The two sets of d-bands associated with the components are found to hybridize separately with the conduction band. Dissert. Abstr.

N78-21251 Ohio State Univ., Columbus.
THE EXCHANGE CONSTANT OF GERMANIUM SUBSTITUTED YTTRIUM IRON GARNET FILMS Ph.D. Thesis
Anthony Charles Gerhardstein 1977 116 p
Avail: Univ. Microfilms Order No. 77-31875

The exchange stiffness constant of calcium and germanium substituted yttrium iron from garnet was measured using ferromagnetic resonance techniques. Single crystal thin films, approximately 1 micron thick, grown by liquid phase epitaxy on [111] oriented Gd3Ga5O12 substrates were used. Germanium concentrations were determined from the depression of the Curie temperature and ranged from 0.1 to 1.4 per formula unit. The room temperature spin wave spectra of all samples were measured at 9 GHz and at 23 GHz and the exchange constants were determined from the positions of the exchange spin wave modes. These results were compared with the predictions of a percolation model and with the predictions of a model based on the random phase approximation and a reasonable agreement is found in both cases. The effective g value of all samples was also measured. Dissert. Abstr.

N78-21252 Case Western Reserve Univ., Cleveland, Ohio.
INVESTIGATION OF THE SURFACE ROUGHNESS OF EVAPORATED COPPER FILMS BY OPTICAL SCATTERING Ph.D. Thesis
Frank Jansen 1977 110 p
Avail: Univ. Microfilms Order No. 7730991

The surface structure factor was calculated for metal film, deposited on a smooth substrate by evaporation. The calculation took into account the two competing processes of roughening by the random nature of the deposition and flattening by surface diffusion. An apparatus that can measure the intensity of the diffuse scattered light of metal surfaces as a function of rotation angle of the surface was designed and constructed. The angle between the light source and the detector was fixed. The specimens studied are Cu thin films. By application of first order scattering theory the surface factor can be evaluated from the experimental data. The applicability of first order scattering theory was determined by investigation of the polarization aspects of theory. The cross polarization intensity was predicted to be zero when the plane of incidence and scattering are the same.
Dissert. Abstr.

N78-21253 Case Western Reserve Univ., Cleveland, Ohio.
INFLUENCE OF METAL VARIABLES ON THE STRUCTURE AND PROPERTIES OF HEAVY SECTION DUCTILE IRON Ph.D. Thesis
Randolph Clifford Helmink 1977 204 p
Avail: Univ. Microfilms Order No. 7730989

The variables included changes in processing and chemical composition. The processing factors were amount and type of postinoculant, inmold magnesium and postinoculation treatments and holding time after the magnesium and postinoculation treatments with and without late additions. The chemical variations were: residual magnesium content, base sulfur level, manganese and silicon contents, and alloying and tramp elements with and without rare earth additions. A new graphite form classification was proposed which ranks the various forms in order of increasing influence on the mechanical properties. As cast pearlitic ductile iron produced by alloying is prone to embrittlement from segregation of the alloying elements to the cell boundaries. This embrittlement can be reduced by heat treatment. Inmold magnesium and postinoculation treatments are

acceptable methods for producing heavy section in ductile iron.
Dissert. Abstr.

N78-21254 California Univ., Berkeley.
THE INFLUENCE OF RETAINED AUSTENITE ON THE THICK SECTION MECHANICAL PROPERTIES OF A COMMERCIAL LOW ALLOY ULTRA-HIGH STRENGTH STEEL Ph.D. Thesis
Ronald Martin Horn 1977 163 p
Avail: Univ. Microfilms

The relationships between microstructure, mechanical, and fracture properties were investigated for thick sections following air cooling and tempering in a silicon-modified steel. This steel which has high pearlite hardenability achieves high strength levels after very slow cooling. Slow cooling also leads to high levels of retained austenite (up to 30%). Properties were determined for microstructures equivalent to those developed through air cooling and tempering of 2.5, 5.0, 10.0 and 15 cm thick plates. Simulated slow cooling was performed on small specimens to model the thicker sections. Fracture toughness and Charpy V-notch behavior were used to evaluate fracture properties while both round and flat tensile specimens were used to measure mechanical properties. Emphasis was placed on determining the role of the austenite on these properties. Dissert. Abstr.

N78-21255 California Univ., Los Angeles.
A STUDY OF THE EFFECT OF CARBON UPON THE ELEVATED TEMPERATURE MECHANICAL, FRACTURE AND STATIC LOAD CRACK EXTENSION BEHAVIOR OF AUSTENITIC STAINLESS STEEL Ph.D. Thesis
Phillip Lisle Jones 1977 262 p
Avail: Univ. Microfilms Order No. 7730926

From tensile tests conducted at 760 C, it was determined that both the yield and fracture strength increase in proportion to the depth of the carbon case. Along with the sharp decrease in tensile ductility observed, a transition from a ductile, transgranular to a brittle, intergranular type fracture mode was noted as a function of increasing depth. Static load crack propagation tests were conducted in both an inert and carburizing gas atmosphere between 650 C and 800 C. From the results obtained in tests conducted at 750 C and 800 C in a carburizing atmosphere, it was determined that creep crack growth exponents remain the same and, as in tests conducted in an inert environment, the crack growth rate is controlled by the local displacement rate. Dissert. Abstr.

N78-21256 Pittsburgh Univ., Pa.
A FRACTURE MECHANICS ANALYSIS OF THE KINETICS OF STRESS-CORROSION CRACK GROWTH IN A HIGH-STRENGTH 12Ni-5Cr-3Mo MARAGING STEEL Ph.D. Thesis
Stephen Robert Novak 1977 322 p
Avail: Univ. Microfilms Order No. 7723559

The study consisted of four main parts including: (1) development of an experimental crack length (a sub i) measurement technique; (2) complete evaluation of the influence of the experimental technique developed; (3) evaluation of stress-corrosion cracking kinetic behaviors of 12Ni-5Cr-3Mo maraging steel in laboratory studies conducted under various mechanical and electrochemical conditions; and (4) evaluation of the corresponding SCC kinetics behavior of 12Ni-5Cr-3Mo maraging steel in natural sea water (in situ). All tests were conducted using standard 1 inch thick modified wedge-opening loading specimens that were bolt-loaded to conditions of constant load-line displacement. Dissert. Abstr.

N78-21257 State Univ. of New York, Stony Brook.
VARIATION OF INTERDIFFUSION COEFFICIENT AND RATIO OF INTRINSIC DIFFUSION COEFFICIENTS WITH COMPOSITION IN THE NiAl (DELTA) PHASE OF THE Al-Ni SYSTEM Ph.D. Thesis
Srinivasan Shankar 1977 125 p
Avail: Univ. Microfilms Order No. 78-00547

Interdiffusion coefficients, D, at 950 to 1150 C and the ratio of intrinsic diffusion coefficients, D sub Ni/D sub Al, at 1100 C were measured as a function of composition in the NiAl (delta) phase of the Al-Ni system using a vapor-solid technique (pack aluminization). Diffusivity values were also obtained for the Ni3Al (epsilon) and Ni-rich solid solution (zeta) phases from 950 to 1150 C. The D values measured by this technique agree very well with the D values obtained from solid-solid couples. The D in NiAl (delta) decreases by two orders of magnitude from the phase boundary composition on the low-Al side reaching a minimum at 48-49 at% Al and changing by three orders of magnitude from the composition at the minimum to that at the high-Al phase boundary. D sub Ni/D sub Al in NiAl (delta) has a value of about 4.5 in low-Al NiAl (delta) which decreases gradually to a value of 2.0 at the stoichiometric composition. Dissert. Abstr.

N78-21258 Utah Univ., Salt Lake City.
MICROSTRUCTURE EVOLUTION DURING SINTERING OF BETA -ALUMINA COMPOSITIONS Ph.D. Thesis
Arun Dinker Jatkar 1977 140 p
Avail: Univ. Microfilms Order No. 78-00895

The microstructure evolution during high-temperature (approx. 1600 C) sintering of beta double prime-alumina compositions (8.7-9.0 w/o Na2O0.7-0.8 w/o Li2O-bal. Al2O3) was examined. The effects of external additions of fully converted beta double prime-alumina seeds on the microstructure and as-sintered properties (density, ionic resistivity, strength etc.) were studied. The availability of the liquid phase capable of promoting a rapid growth of the beta double prime-alumina nuclei is strongly influenced by the extent of chemical homogeneity in the specimen; especially with respect to the distribution of lithium. The more uniform the lithium distribution, the less probable the formation of such a liquid phase. This is reflected in longer incubation periods for the onset of an exaggerated grain growth.
Dissert. Abstr.

N78-21259 Northwestern Univ., Evanston, Ill.
MASS TRANSPORT AND ELECTRICAL CONDUCTIVITY IN OXIDES CONTAINING A SUBMICRON DISPERSION OF A SECOND OXIDE PHASE Ph.D. Thesis
Gary Mark Crosbie 1977 139 p
Avail: Univ. Microfilms Order No. 78-00697

Due to the electrically charged nature of defects in oxides, possibilities exist to reduce diffusivity by the control of oxide microstructure. Experiments were carried out at high temperatures on two phase mixtures of binary metal oxides. In particular, matrix oxides of TiO2 and Cu2O were prepared with dispersed phases of SiO2. Results indicate that reductions of the order of ten times in chemical diffusivity could be produced in TiO2 if the second phase particles were sufficiently small. A concurrent increase in electrical conductivity was also produced. The dependence on volume fraction from 0.005 to 0.1 and the dependence on particle sizes from 50A were studied.
Dissert. Abstr.

N78-21260 Northwestern Univ., Evanston, Ill.
AN X-RAY STUDY OF CONTINUOUS ORDERING AND ITS KINETICS IN BINARY ALLOYS Ph.D. Thesis
Haydn Hai-Dung Chen 1977 126 p
Avail: Univ. Microfilms Order No. 78-00692

Diffuse X-ray scattering techniques were employed to study the nature of continuous ordering in single crystals of several binary alloys, Cu3Au, (Cu81.5)(Au18.5), CoPts and (Fe70.8)(Al29.2). A premonitory effect was confirmed in Cu3Au, which underwent a first order phase transition. It is shown that this effect corresponds to regions of metastable long range order coexisting with the disordered matrix near but just above Tc. The existence of these so called heterophase fluctuations manifests itself in various anomalies close to Tc. These include a drastic change in the intensities of fundamental reflections, the splitting into optical modes of phonon branches, large Au atom displacements and anharmonic interactions. This heterophase region was shown to extend as far as 5 C above the transition point.
Dissert. Abstr.

N78-21261 Washington State Univ., Pullman.
GRAVITY SEGREGATION OF PRIMARY PARTICLES DURING SOLIDIFICATION OF BINARY EUTECTIFEROUS ALLOYS Ph.D. Thesis
Surya Prabhakararao Kodali 1977 167 p
Avail: Univ. Microfilms Order No. 7800309

A study was made of the effect of cooling rate and

composition on gravity segregation and morphology of primary silicon and germanium particles in selected silicon or germanium-rich alloys of gold-silicon, silver-silicon, silver-germanium, and gold-germanium. In general, the results showed that gravity segregation occurs only if the morphology of the primary particles does not interfere. Primary silicon and germanium segregate until their morphology is changed by rapid cooling to large faceted plates that effectively block other particles from rising in the denser liquid. Primary gold and silver appear not to segregate to the bottom because they form large dendrites with interlocking arms that become entangled. Dissert. Abstr.

N78-21262 South African Bureau of Standards, Pretoria.
TABLES OF BRINELL AND VICKERS HARDNESS VALUES FOR METALLIC MATERIALS WITH FLAT SURFACES, AND OF CORRECTION FACTORS (VICKERS) FOR CURVED SURFACES
1977 71 p In ENGLISH and AFRIKAANS Supersedes SABS-055-1595
(SABS-055A-1977; ISBN-0-626-04306-9) Copyright. Avail: Issuing Activity

The purpose of this publication is to provide the values for Brinell and Vickers hardness tests in a compact and easily accessible form when use of the code as a whole is not intended. Author

N78-21263 South African Bureau of Standards, Pretoria.
CODE OF PRACTICE FOR THE CUPPING TEST FOR SHEET AND STRIP METAL (MODIFIED ERICHSEN TEST)
1977 23 p In ENGLISH and AFRIKAANS
(SABS-0138-1977; ISBN-0-626-04477-4) Copyright. Avail: Issuing Activity

The equipment and procedures for determining the suitability of both ferrous and nonferrous sheet and strip for stretch forming using the modified Erichsen cupping test are described. Test conditions are specified for materials of thickness 0,2-3 mm and of minimum width 30 mm. Author

N78-21264 South African Bureau of Standards, Pretoria.
CODE OF PRACTICE FOR METHODS FOR HARDNESS TESTING OF METALLIC MATERIALS
1977 99 p In ENGLISH and AFRIKAANS Revised Supersedes SABS-055-1955
(SABS-055-1977-Rev-1; ISBN-0-626-04425-1) Copyright. Avail: Issuing Activity

The equipment and procedures for determining the hardness of metallic materials by the Brinell, Vickers, and Rockwell methods and the applicability of these methods are discussed. The procedures for the verification of testing machines used for measuring hardness by the above methods are described as well as the calibration of the standard Brinell, Vickers, and Rockwell hardness blocks that are to be used for the indirect verification of the machines. Author

N78-21265*# Colt Industries, Inc., Pittsburgh, Pa. Crucible Materials Research Center.
FABRICATION OF STAINLESS STEEL CLAD TUBING Final Report
C. W. Kovach 7 Apr. 1978 102 p
(Contract NAS3-20098)
(NASA-CP-135347) Avail: NTIS HC A06/MF A01 CSCL 11F

The feasibility of producing stainless steel clad carbon steel tubing by a gas pressure bonding process was evaluated. Such a tube product could provide substantial chromium savings over monolithic stainless tubing in the event of a serious chromium shortage. The process consists of the initial assembly of three component tubesets from conventionally produced tubing, the formation of a strong metallurgical bond between the three components by gas pressure bonding, and conventional cold draw and anneal processing to final size. The quality of the tubes produced was excellent from the standpoint of bond strength, mechanical, and forming properties. The only significant quality problem encountered was carburization of the stainless clad by the carbon steel core which can be overcome by further refinement through at least three different approaches. The estimated cost of clad tubing produced by this process is greater than that for monolithic stainless tubing, but not so high as to make the process impractical as a chromium conservation method. Author

N78-21266*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRENGTH ENHANCEMENT PROCESS FOR PREALLOYED POWDER SUPERALLOYS
William J. Waters and John C. Freche 1977 31 p refs Presented at the TMS-AIME Fall Meeting, Chicago, 24-27 Oct. 1977
(NASA-TM-78834; E-9544) Avail: NTIS HC A03/MF A01 CSCL 11F

A technique involving superplastic processing and high pressure autoclaving was applied to a nickel base prealloyed powder alloy. Tensile strengths as high as 2865 MN/sq m at 480 C were obtained with as-superplastically deformed material. Appropriate treatments yielding materials with high temperature tensile and stress rupture strengths were also devised. Author

N78-21267*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRAINRANGE PARTITIONING BEHAVIOR OF THE NICKEL-BASE SUPERALLOYS, RENE' 80 AND IN 100
G. R. Halford and A. J. Nachtigall Apr. 1978 17 p refs Presented at the 46th Meeting of the Struct. and Mater. Panel of AGARD Specialists Meeting on Characterization of Low Cycle High Temp. Fatigue by Strainrange Partitioning Method, Aalborg, Denmark, 9-14 Apr. 1978
(NASA-TM-78828) Avail: NTIS HC A02/MF A01 CSCL 11F

A study was made to assess the ability of the method of Strainrange Partitioning (SRP) to both correlate and predict high-temperature, low cycle fatigue lives of nickel base superalloys for gas turbine applications. The partitioned strainrange versus life relationships for uncoated Rene' 80 and cast IN 100 were also determined from the ductility normalized-Strainrange Partitioning equations. These were used to predict the cyclic lives of the baseline tests. The life predictability of the method was verified for cast IN 100 by applying the baseline results to the cyclic life prediction of a series of complex strain cycling tests with multiple hold periods at constant strain. It was concluded that the method of SRP can correlate and predict the cyclic lives of laboratory specimens of the nickel base superalloys evaluated in this program. Author

N78-21268*# United Technologies Research Center, East Hartford, Conn.
STUDY OF THE EFFECTS OF GASEOUS ENVIRONMENTS ON SULFIDATION ATTACK OF SUPERALLOYS Final Report
John G. Smeggil and Norman S. Bornstein Nov. 1977 166 p refs
(Contract NAS3-20039)
(NASA-CR-135348; R77-912613-5) Avail: NTIS HC A08/MF A01 CSCL 11F

Studies were conducted to examine the effect of the gaseous corrodents NaCl, HCl, and NaOH on the high temperature oxidation and Na2SO4-induced corrosion behavior of the alumina former NiAl, the chromia former Ni-25 wt.% Cr, elemental Cr, and the superalloy B-1900. Experiments were conducted at 900 and 1050 C in air in the presence and absence of the gaseous corrodents. Effects involving both reaction rates and microstructural changes in oxide morphology were observed due to the presence of these corrodents at levels anticipated to be present in operating industrial and marine gas turbines. The effect of gaseous NaCl, HCl, and possibly NaOH on NiAl in simple oxidation was to remove aluminum from below the protective alumina layer and to simultaneously weaken the adherence of the protective alumina oxide scale to the substrate. The aluminum removed from below the oxide scale was redeposited on its surface as alpha-Al2O3 whiskers. With respect to the chromia formers, gaseous NaCl and HCl promoted breakaway oxidation kinetics and changes in the microstructures of the oxide scales. Author

N78-21269*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INFLUENCE OF FRETTING ON FLEXURAL FATIGUE OF 304 STAINLESS STEEL AND MILD STEEL
Robert C. Bill (Army R and T Labs.) and Douglas A. Rohn Apr. 1978 19 p refs

(NASA-TP-1193; E-9414) Avail: NTIS HC A02/MF A01 CSCL 11F

Fretting fatigue experiments conducted on 304 stainless steel using a flexural fatigue test arrangement with bolted on fretting pads demonstrated that fatigue life is reduced by at least a factor of 10 in the 265 to 334 MPa (38,500 - to 48,500 psi) nominal flexural fatigue stress range. In addition, experiments in which the fretting pads were removed after selected numbers of cycles, followed by continued flexural fatigue without fretting show that continued fretting beyond 50,000 cycles does not significantly further reduce fatigue life of 304 stainless steel at 317 MPa (46,000 psi). Microscopic examination of the fretted contact areas revealed fracture initiation sites as well as numerous cracks that did not propagate to failure. Flexural fretting fatigue experiments performed on mild steel showed an insensitivity of fatigue life to the incidence of fretting under flexural stress conditions of from 162 to 217 MPa (23,500 to 31,500 psi). Author

N78-21270# Pratt and Whitney Aircraft Group, West Palm Beach, Fla. Government Products Div.

APPLICATION OF SUPERPLASTIC STEELS Semiannual Progress Report, 1 Jun. - 30 Nov. 1977

E. R. Slaughter and R. G. Bourdeau Dec. 1977 18 p refs

(Contract F33615-77-C-5114)

(AD-A049469; FR-9489) Avail: NTIS HC A02/MF A01 CSCL 13/8

This program is being conducted to demonstrate that the GATORIZING forge process can be applied to the precision forging of superplastic steels, and to determine the economic benefits gained over conventional forging and subsequent machining to final shape. During this report period, the thermomechanical processing of an ultrahigh-carbon steel was initiated to convert its cast structure to a characteristic fine grained superplastic structure. Alloy development studies were initiated with laser treated arc cast buttons which were extruded and thermomechanically processed in such a way that the stability of recrystallized fine grained structures could be evaluated. Author (GRA)

N78-21271# Wichita State Univ., Kans. Dept. of Mechanical Engineering.

FATIGUE IN ADHESIVELY BONDED LAMINATES Final Technical Report, Mar. 1976 - Sep. 1977

J. A. Alic Oct. 1977 49 p refs

(Grant AF-AFOSR-2994-76)

(AD-A049529; AFOSR-77-1300TR) Avail: NTIS HC A03/MF A01 CSCL 11/1

Fatigue crack propagation (FCP) and fatigue lifetime tests have been performed on several types of adhesively bonded aluminum alloy laminates. The laminate systems included several varieties of all-7075-T6(51) laminates--having 2, 4, 8 or 22 layers--as well as bi-material laminates combining 7075-T6 and 2024-T351 alloys. Among the conclusions of the study are: --FCP rates in crack divider laminates for which all layers are the same are comparable to those in the monolithic alloy. --FCP rates in bi-material 7075-T6/2024-T351 laminates are intermediate between those for the two alloys in monolithic form; over a considerable range of growth rates the bi-material laminates give FCP rates significantly lower than the averages of the two constituents. --Fatigue life-times of 7075-T6 8- and 22-layer laminates tested in tension-tension fatigue (R=0.1) are inferior to monolithic 7075-T6 alloy in either notched or unnotched forms; this is contrary to previous results for reversed bending. GRA

N78-21272# Cincinnati Univ., Ohio.

THE EFFECT OF VARYING QUENCH RATES AND HEATING RATES ON THE AGING RESPONSE OF AN ALUMINUM POWDER ALLOY Final Technical Report, Oct. 1975 - Sep. 1976

Walter M. Griffith (AFML, Wright-Patterson AFB, Ohio) and Marlin M. Cook Wright-Patterson AFB, Ohio AFML Jul. 1977 30 p refs

(Contract F33615-76-C-5227; AF Proj. 2418; AF Proj. 7351)

(AD-A0497444; AFML-TR-77-67) Avail: NTIS HC A03/MF A01 CSCL 11/6

This research examines the effect of varying quench rates and the effect of varying heating rates on the aging response of powder aluminum MA87 alloy. The effect of a six-day room temperature pre-age was also considered. The results obtained are compared with results of similar research on 7075 ingot product and supplemented with electron microscopy. The results indicate little difference in terms of hardness, in the response of MA87 and 7075. This suggests that the quench sensitivity of both alloys is similar and is attributable to the same mechanism. Author (GRA)

N78-21273# Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.

ALLOY CORROSION-FUNDAMENTAL STUDIES OF DISSOLUTION AND PASSIVITY OF ALLOYS AND COMPOUNDS Interim Report, 1 Mar. 1976 - 28 Feb. 1977

Jesse B. Lumsden and Roger W. Staehle 5 Dec. 1977 33 p refs

(Contract N00014-75-C-0665; NR Proj. 036-085)

(AD-A049848; OSURF-784131-2) Avail: NTIS HC A03/MF A01 CSCL 11/6

The effects of Si additions to Fe on the stability of the passive film have been investigated over the pH range from 0 to 10. Silicon, in concentrations below 14.5% decreased the stability of the film. In sulfate solutions the passive current density was up to an order of magnitude less for the Fe-14.5 Si alloy relative to the Fe-8 Si alloy; the active peak decreased three orders of magnitude. In 0.1 N HCl, Fe-14.5 Si had a passive region. There was no passive zone for Fe, Fe-3 Si, or Fe-8 Si alloys in this solution. Surface analysis techniques indicate that the abrupt change in stability with the addition of 14.5% Si is not the result of an SiO2 film on the surface. Author (GRA)

N78-21274# Illinois Univ., Urbana-Champaign. Dept. of Metallurgy and Mining Engineering.

PITTING IN ALUMINUM Final Report, 1 Sep. 1975 - 30 Sep. 1976

M. Metzger 19 Aug. 1977 4 p refs

(Contract DAAG29-76-G-0039; DA Proj. 1T1-61102-BH-57)

(AD-A049854; ARO-12821.2-MS) Avail: NTIS HC A02/MF A01 CSCL 11/6

Observations by electron microscopy of transient pitting during film growth in the passive state were extended to a lower potential. Electrochemical studies in sulfuric acid of the effect on cathode behavior of copper contents from 0.1 to 600 ppm showed that cathode polarization decreases with time, that corrosion potential rises with time and that the effect is accelerated by chloride additions and can be substantial even at 1 ppm Cu. It is proposed that the formation of cathodes of copper during corrosion occurs in transient pits. Author (GRA)

N78-21275# Naval Postgraduate School, Monterey, Calif.

EFFECTS OF THERMO-MECHANICAL PROCESSING ON ALUMINUM-MAGNESIUM ALLOYS CONTAINING HIGH WEIGHT PERCENTAGE MAGNESIUM M.S. Thesis

Terry Lee Glover Dec. 1977 67 p refs

(AD-A050092) Avail: NTIS HC A04/MF A01 CSCL 11/6

Cast ingots of three Al-Mg alloys, containing 7% Mg, 15% Mg, and 19% Mg, were obtained from Kaiser Aluminum and Chemical Corporation Center for Technology. Billets were machined from these castings and upset forged at .9% of either the solvus or eutectic temperature, as appropriate, to a true strain of 1.5. These alloys were then evaluated by compressive stress-strain testing at various temperatures and strain rates to determine both the ambient and elevated temperature characteristics. GRA

N78-21276# Georgia Inst. of Tech., Atlanta. School of Physics.

OPTICAL SURFACE STUDIES OF TITANIUM AND TITANIUM-ALUMINUM ALLOYS WITH APPLICATION TO THE MECHANISM OF PASSIVITY AND NON-DESTRUCTIVE TESTING Final Report, 1 Jul. 1975 - 30 Sep. 1977

James R. Stevenson 15 Nov. 1977 49 p refs

(Grant AF-AFOSR-75-2773)

(AD-A050212; AFOSR-78-0079TR) Avail: NTIS HC A03/MF A01 CSCL 11/6

Optical reflectance studies and Auger spectroscopy have been used to study Ti and Ti-Al alloy surfaces to study mechanisms relative to the formation of passive surfaces. Instrumentation has been developed for rapid data acquisition so that growth

kinetics of oxide formation on the surface can be followed with non-destructive optical techniques. The use of synchrotron radiation has been an important tool in the surface studies. The measured optical reflectivity of titanium and titanium-aluminum are discussed in the light of new theoretical calculations. New theoretical methods in the analysis of Auger data has resulted in a significant improvement of information about the chemical environment of the surface. Author (GRA)

N78-21277# Southwest Research Inst., San Antonio, Tex.
NONDESTRUCTIVE EVALUATION OF METAL FATIGUE Final Scientific Report, Jan. 1975 - Sep. 1977
F. N. Kusenberger, G. A. Matzkanin, J. R. Barton, P. H. Francis, and J. Lankford Nov. 1977 74 p refs
(Contract F44620-75-C-0042; AF Proj. 2307; AF Proj. 9782)
(AD-A049539; AFOSR-77-1313TR) Avail: NTIS HC A04/MF A01 CSCL 11/6

Nondestructive evaluation investigations have been conducted of surface entering fatigue cracks in rod-shaped tensile specimens of AISI 4340 and HY 180 steels. To alleviate the need for constant manual monitoring of the fatigue machine for specimens requiring many stress cycles, an automated monitoring capability based on detection of fatigue cracks by surface wave ultrasonics was fabricated. Fatigue cracks up to 0.050 in. long were studied using magnetic perturbation, surface wave ultrasonics and Barkhausen noise analysis. Results showed the minimum detectable flaw size in HY 180 steel using surface wave ultrasonics to be 2 to 3 times the minimum size detectable in AISI 4340 steel. Also an applied load is necessary to ultrasonically detect fatigue cracks as long as 0.030 in. in HY 180. Extensive magnetic perturbation measurements were made on an AISI 4340 steel specimen cycled near yield. Attempts to interpret the behavior of the signal amplitude with applied static stress in terms of available closure models were not entirely successful. Indications are that the effect of plastic deformation in the vicinity of the crack on the magnetic perturbation signal must be taken into account. The magnetic perturbation signal peak separation was found to depend on crack length in a nonlinear fashion and to be affected by the plastic zones at the crack tips. Other investigations conducted included fractography to study the fracture surfaces and fatigue crack initiation sites in AISI 4340 and HY 180, microhardness measurements of plastic zones, and extension of an analytical model for calculation of magnetic leakage fields from surface entering fatigue cracks. Author (GRA)

N78-21278# South Dakota School of Mines and Technology, Rapid City. Div. of Engineering.
AN INVESTIGATION OF THE INFLUENCE OF SHOCK-WAVE PROFILE ON THE MECHANICAL AND THERMAL RESPONSES OF POLYCRYSTALLINE IRON Interim Technical Report
G. A. Stone and R. N. Orava 30 Jun. 1977 46 p refs
(Grant DAAG29-76-G-0181)
(AD-A049764; ARO-12800.1-MSX) Avail: NTIS HC A03/MF A01 CSCL 11/6

The purpose of this investigation is to study the influence of the shock-wave profile on the mechanical response of polycrystalline iron. The objective of this Interim Technical Report is to provide information in regard to significant progress made in this study. The three shock-wave parameters associated with the shock-wave profile are peak pressure, duration of peak pressure, and rarefaction rate. It is now evident that the major parameter of importance in developing mechanical properties in shock-loaded low carbon iron alloys is peak pressure. Pressure duration plays a role in the 13 to 33 GPa pressure range for duration, less than 1 mu/sec. Below 13 GPa and above 33 GPa the mechanical properties developed were not sensitive to the peak pressure durations used in the study. The alpha yields epsilon yields alpha phase transformation is playing such a major role in microstructure development above 13 GPa that any modification to structure associated with rarefaction rate is a second order contribution. This study validates previous work on shock loading of iron where rarefaction rate was not considered. GRA

N78-21279# Illinois Univ., Urbana-Champaign. Dept. of Metallurgy and Mining Engineering.
STRUCTURE AND DEFORMATION CHARACTERISTICS OF RHEOCAST METALS Annual Report, 24 Jun. 1976 - 23 Jun. 1977
R. Mehrabian, S. D. E. Ramati, G. J. Abbaschian, and D. G. Backman Dec. 1977 42 p refs
(Contract DAAG46-76-C-0046; DA Proj. 1T1-62105-AH-84)
(AD-A049975; AMMRC-CTR-77-30; AR-1) Avail: NTIS HC A03/MF A01 CSCL 13/8

This is the first annual report describing research at the University of Illinois at Urbana-Champaign, aimed at establishing the feasibility of producing parts to net or near-net shapes starting with Rheocast preforms by forging-type, THIXOFORGING, operations. Ingots of Sn-15% Pb alloy and aluminum alloys 6061 and A356 were heated to temperatures above liquidus and in the liquid-solid range. The partially solidified charge, Rheocast, materials were previously made in a continuous slurry producer. Sound flanged shaped cup parts with good mechanical properties and unidirectionally solidified cylinders were produced in a 50-ton hydraulic press. Die thermal behavior was experimentally determined from thermocouples located at different distances from the metal-die interface. Measured maximum die temperatures were lower when the initial charge material was partially solid or when applied pressure was reduced. A one-dimensional computer heat flow program was developed to simulate heat flow in the cylinder parts and the steel dies. Correlation of computer predictions and measured temperatures were used to calculate values of the heat transfer coefficients at the metal-die interface prior to and after pressurization. The heat transfer coefficients increase by one order of magnitude or more upon application of 9.1 x ten to the 7th power Pa pressure. GRA

N78-21280# Air Force Systems Command, Wright-Patterson AFB, Ohio.
METHOD OF PLASTIC DEFORMATION OF METALS AND ALLOYS
S. Z. Figlin, A. B. Gerchikov, and Yu. G. Kalpin 14 Sep. 1977 9 p Transl. into ENGLISH from Patent (USSR), no. 159382, 7 Dec. 1963 p 1-2
(AD-A049391; FTD-ID(RS)T-1552-77) Avail: NTIS HC A02/MF A01 CSCL 11/6

Method of plastic deformation of metals and alloys with heating of the billet in a molten medium, for example, of salts is distinguished by the fact that for the purpose of deforming high-alloy, low-plastic alloys with a narrow working temperature interval the billet is deformed directly in the molten medium which surrounds it and the tool. Author

N78-21281# Clemson Univ., S.C. Coll. of Engineering.
ANISOTHERMAL OXIDATION OF TITANIUM AND ITS ALLOY Final Scientific Report, 1 Oct. 1975 - 31 Dec. 1977
James S. Wolf Dec. 1977 31 p refs
(Grant AF-AFOSR-2919-76)
(AD-A050053; AFOSR-78-0069TR) Avail: NTIS HC A03/MF A01 CSCL 11/6

The objective of this research has been to provide from laboratory experiments and analyses a capability for the prediction of oxidation-associated ignition of reactive metals; especially titanium and its alloys. Emphasis was placed upon the generation of basic information for subsequent application to technical problem areas where high rates of heating prevail or are suspect, as in engine fires and laser-assisted ignition. Author (GRA)

N78-21282# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
METASTABLE METALLIC SUPERCONDUCTORS WITH HIGH TRANSITION TEMPERATURES AND COMPOSITE SUPERCONDUCTORS Final Report, 1 Jan. 1974 - 31 Dec. 1977
John R. Gavaler and Michael R. Daniel 31 Dec. 1977 22 p refs
(Contract F44620-74-C-0042)
(AD-A050055; AFOSR-78-0067TR; Rept-77-9F1-NUSUC-R2)
Avail: NTIS HC A02/MF A01 CSCL 11/6

Chemical vapor deposition (CVD) was found to be a practical method for preparing large quantities of Nb-Ge. The fabrication of Nb-Ge multifilamentary and tape conductors by this method was shown to be feasible. CVD Nb-Ge had critical temperatures and upper critical fields comparable to the sputtered material. Critical-current densities were lower. Second-phase doping was

shown effective toward improving current-carrying capacity. A new Nb-Ge growth method (reactive sputtering of niobium in Argon/Germane) was demonstrated and its applicability for use in a magnetron sputtering system evaluated. A study of the effect of impurities (oxygen, nitrogen and silicon) on sputtered Nb-Ge films indicated that each of these impurities can stabilize the high-critical temperature metastable A15 phase. An investigation of the bronze diffusion process illustrated why A15 Nb-Ge cannot readily be made by this method. The formation of A15 Nb-Ga by bronze diffusion was achieved. The preparation of superconducting niobium and A15 structure Nb-Sn was accomplished by liquid sodium reduction of the halides. The anomalously high upper critical field of sputtered Nb-N film was shown to be due to a surface critical field. Author (GRA)

N78-21283# Oak Ridge National Lab., Tenn.
COMPOSITION OF ETA CARBIDE IN HASTELLOY N AFTER AGING 10,000 HR AT 815 C
J. M. Leitnaker, G. A. Potter, D. J. Bradley, J. C. Franklin, and W. R. Laing Nov. 1977 26 p refs
(Contract W-7405-eng-26)
(ORNL-5340) Avail: NTIS HC A03/MF A01

The eta carbide composition in Hastelloy N containing 0.7 wt percent Si in the alloy approaches M12C rather than M6C as indicated in the alloy literature. The silicon content of the eta phase in this case was about 25 at. percent, much higher than has been observed in less highly alloyed material. The data do not permit a definition of the limiting compositions of the phases. ERA

N78-21284# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
BASIC CREEP-RUPTURE TESTING AT 1100 DEG F (593 DEG C) OF TYPE 304 STAINLESS STEEL FOR UNIAXIALLY LOADED SPECIMENS WITH STRESS AND STRAIN GRADIENTS
M. J. Manjoine Jun. 1977 68 p refs
(Contract EY-76-C-02-3045-006)
(WARD-HT-3045-26) Avail: NTIS HC A04/MF A01

The purpose of these tests under steady load creep rupture was: (1) to measure the strain distribution at a hole in a plate, the strain and time for crack initiation and the crack growth rate under steady load; (2) to investigate the notch sensitivity as a function of stress and stress state; (3) to determine the characteristics of crack initiation and growth in notched bars under steady load; and (4) to measure the strain distribution in a plate with an eccentric load, the relaxation of the bending load, and the strain and time for crack initiation. ERA

N78-21285# California Univ., Livermore. Lawrence Livermore Lab.
DETERMINATION OF SOUND VELOCITY IN LIQUID METALS AT TEMPERATURES ABOVE 4000 K
G. R. Gathers, J. W. Shaner, C. A. Calder, and W. W. Wilcox 6 Jun. 1977 8 p refs Presented at 7th Symp. on Thermophys. Properties, Gaithersburg, Md., 10-12 May 1977 Revised Submitted for publication
(Contract W-7405-eng-48)
(UCRL-79322-Rev-1; Conf-770537-9) Avail: NTIS HC A02/MF A01

A noncontacting technique that takes very little time and can be used at very high temperatures was used with an isobaric expansion apparatus. This apparatus measures the thermal expansion, enthalpy, and temperature of wire samples electrically heated under high pressure argon gas. Sound velocity measurement would allow a determination of the Gruneisen parameter gamma/sun G/, specific heat C/sub V/, isothermal compressibility K/sub T/, enthropy derivative (delta S/delta v)/sub T/, and internal energy derivative (delta u/delta v)/sub T/. ERA

N78-21286# California Univ., Livermore. Lawrence Livermore Lab.
THERMOPHYSICAL AND TRANSPORT PROPERTIES OF METALS AT HIGH PRESSURE AND VERY HIGH TEMPERATURE
J. W. Shaner and G. R. Gathers 28 Jun. 1977 13 p refs Presented at 6th AIRAPT Intern. High-Pressure Conf., Boulder, Colo., 25-29 Jul. 1977 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-79586; Conf-770706) Avail: NTIS HC A02/MF A01

Simultaneous measurements of enthalpy, specific volume, temperature, and electrical resistivity for lead and uranium were measured. From the measured data, estimates of the bulk modulus and sound velocity in these metals were made. ERA

N78-21287# Electricity Council Research Center, Capenhurst (England).
METALLOGRAPHY OF COMMERCIAL LEAD AND LEAD ALLOYS USED IN THE ELECTRICITY SUPPLY INDUSTRY
Anita Fursey Mar. 1977 17 p refs
(PB-276437/1; ECRC/N-1034) Avail: NTIS HC A02/MF A01 CSCL 11F

Electrolytic polishing without using any abrasive mechanical methods can produce very satisfactory metallographic specimens of commercial lead and lead alloys. Preparation before electropolishing is important to achieving good results, and the method described in detail was used successfully for lead cable sheaths, lead battery components, and a variety of alloys used in the electricity supply industry. GRA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N78-21288 Cornell Univ., Ithaca, N. Y.
RELATIONSHIPS BETWEEN STRUCTURE AND MICROMECHANICS OF SOLVENT CRAZES IN GLASSY POLYMERS Ph.D. Thesis
Heider Georg Krenz 1977 199 p
Avail: Univ. Microfilms Order No. 78-01637

A double exposure holographic interferometry (DEHI) technique was developed and applied to characterize the micromechanics of solvent crazes. This method allowed one to determine the strain energy release rate (SERR), the craze opening displacement, and the stress profile along the craze. In connection with a replica technique DEHI was used to determine the final craze thickness, the original thickness, and therefore the true craze strain. The same parameters were calculated using a new method based on optical interferometry. The craze structure was investigated with transmission electron microscopy, scanning electron microscopy of craze fracture surfaces, and refractive index measurements. The crazing agent-polymer systems investigated were methanol-polystyrene, n-heptane-Ps, methanol polymethyl methacrylate, and ethanol polycarbonate.
Dissert. Abstr.

N78-21289*# United Technologies Research Center, East Hartford, Conn.
DEVELOPMENT OF SiAlON MATERIALS Contractor Report, Jun. 1975 - Sep. 1977
G. K. Layden Dec. 1977 142 p refs
(Contract NAS3-19712)
(NASA-CR-135290; R77-912184-21) Avail: NTIS HC A07/MF A01 CSCL 11B

Cold pressing and sintering techniques were used to produce ceramic bodies in which the major phase was beta prime Si3-Al-O-N4 solid solution. A variety of foreign oxides were used to promote liquid phase sintering, and this resulted in the incorporation of additional solid phases in the ceramic bodies which controlled elevated temperature properties. None of the bodies studied to date exhibited both adequate high temperature mechanical properties and oxidation resistance. Criteria are suggested to guide the formulation of bodies with improved high temperature properties. Author

N78-21290# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF THE FRACTURE MECHANISM FOR SOLID POLYMERS
G. L. Slonimskii, A. A. Askadskii, and V. V. Kazantseva [1977] 6 p refs Transl. into ENGLISH from Mekhan. Polimerov (USSR), no. 5, 1977 p 775-780 Presented at the 3d All-Union Conf. on Polymer Mech., Riga, 1976

Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The creep strength of two polyarylate specimens was investigated. The fracture mechanisms of these two polyarylate polymer solids of identical chemical configuration but cardinally different supermolecular structure and ultimate strength properties were clarified. Author

N78-21291# Lockheed Missiles and Space Co., Palo Alto, Calif.
DESCRIPTION OF THE TEMPERATURE DEPENDENCE OF VISCOELASTIC PROPERTIES OF POLYMERS IN THE DYNAMIC MODE ON THE BASIS OF LINEAR THERMOVISCOELASTICITY THEORY
V. S. Ekelchik, V. S. Ismailov, S. N. Kostritskii, and A. K. Sborovskii [1977] 4 p refs Transl. into ENGLISH from Mekhan. Polimerov (USSR), no. 5, 1977 p 915-918 Presented at the 3d All-Union Conf. on Polymer Mech., Riga, 1976
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

An attempt was made on a quantitative description of the temperature dependence of the dynamical elastic modulus under shear and the loss coefficient of a stiff latticed polymer according to the results of quasistatic creep tests under tension under room and elevated temperature conditions, under the assumption that the instantaneous elastic modulus was a constant independent of the temperature. Results of a computation were compared with experimental data obtained in torsion tests at different temperatures in the free damped vibrations mode. Author

N78-21292# Lockheed Missiles and Space Co., Palo Alto, Calif.
CERTAIN RESULTS OF DETERMINING THE TEMPERATURE DEPENDENCES OF THE THERMOPHYSICAL CHARACTERISTICS OF COMPOSITE POLYMERS
V. L. Strakhov, S. I. Leonova, and A. N. Garashchenko [1977] 5 p refs Transl. into ENGLISH from Inzhen.-Fizich. Zh. (USSR), v. 33, no. 6, 1977 p 1047-1051
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

A method was elucidated and results were presented for the determination of the temperature dependences of the heat conductivity and organo-plastic coefficients at temperatures to 1000 C by thermocouple measurements by the method of the inverse problem of heat conduction. Author

N78-21293# Lockheed Missiles and Space Co., Palo Alto, Calif.
STRESS RELAXATION IN PHYSICALLY NONLINEAR POLYMER MATERIALS UNDER COMBINED TENSION WITH TORSION
M. R. Kilevits and A. F. Kreger [1977] 7 p refs Transl. into ENGLISH from Mekhan. Polimerov (USSR), no. 5, 1977 p 797-803
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Methods used in this discussion for determining the parameters of physically nonlinear polymer material from tests under uniaxial tension or torsion assures satisfactory correspondence between the computed and experimental stress relation curves for the investigated other kinds of loading. The theoretical shear stress relaxation curve, computed by means of parameter which were determined from the approximation of tension stress relaxation curves were located approximately within the limits of the confidence range of an individual measurement. The correspondence between the theoretical and experimental stress relaxation curves in the plane stress state was two-threefold worse in the root mean square relative deviation than was the same correspondence under uniaxial loading. Author

N78-21294*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRICTION AND METAL TRANSFER FOR SINGLE-CRYSTAL SILICON CARBIDE IN CONTACT WITH VARIOUS METALS IN VACUUM
Kazuhisa Miyoshi (Kanazawa Univ., Japan) and Donald H. Buckley Apr. 1978 27 p refs
(NASA-TP-1191; E-9307) Avail: NTIS HC A03/MF A01 CSCL 11G

Sliding friction experiments were conducted with single-crystal silicon carbide in contact with transition metals (tungsten, iron, rhodium, nickel, titanium, and cobalt), copper, and aluminum. Results indicate the coefficient of friction for a silicon carbide-metal system is related to the d bond character and relative chemical activity of the metal. The more active the metal, the higher the coefficient of friction. All the metals examined transferred to the surface of silicon carbide in sliding. The chemical activity of metal to silicon and carbon and shear modulus of the metal may play important roles in metal transfer and the form of the wear debris. The less active and greater resistance to shear the metal has, with the exception of rhodium and tungsten, the less transfer to silicon carbide. Author

N78-21295*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WEAR OF SINGLE-CRYSTAL SILICON CARBIDE IN CONTACT WITH VARIOUS METALS IN VACUUM
Kazuhisa Miyoshi and Donald H. Buckley Apr. 1978 24 p refs
(NASA-TP-1198; E-9360) Avail: NTIS HC A02/MF A01 CSCL 11G

Sliding friction experiments were conducted in vacuum with single crystal silicon carbide (0001) surface in contact with transition metals (tungsten, iron, rhodium, nickel, titanium, and cobalt), copper, and aluminum. The hexagon shaped cracking and fracturing of silicon carbide that occurred is believed to be due to cleavages of both the prismatic and basal planes. The silicon carbide wear debris, which was produced by brittle fracture, slides or rolls on both the metal and silicon carbide and produces grooves and indentations on these surfaces. The wear scars of aluminum and titanium, which have much stronger chemical affinity for silicon and carbon, are generally rougher than those of the other metals. Fracturing and cracking along the grain boundary of rhodium and tungsten were observed. These may be primarily due to the greater shear moduli of the metals. Author

N78-21296# National Bureau of Standards, Washington, D. C. Inorganic Materials Div.
EROSION OF BRITTLE MATERIALS BY SOLID PARTICLE IMPACT Interim Report
B. J. Hockey, S. M. Wiederhorn, and H. Johnson Dec. 1977 27 p refs Sponsored by ONR
(AD-A050252; NBSIR-77-1396) Avail: NTIS HC A03/MF A01 CSCL 11/2

Results are presented which show, that in addition to fracture, plastic deformation occurs and plays an important role in the erosion of brittle materials by solid particle impact. These conclusions are supported by transmission electron microscopy studies of impact damage produced in a wide variety of brittle materials and by erosive wear studies on silicon nitride and alumina. The erosive wear studies also indicate that while erosion resistance is primarily determined by fracture toughness and hardness, the relative importance of these materials parameters depends on the test conditions (e.g. temperature and angle of particle impingement). Author (GRA)

N78-21297# Bristol Univ. (England). H. H. Wills Physics Lab.
THE PHYSICAL MECHANISMS RESPONSIBLE FOR THE WEATHERING OF EPOXY RESINS AND GFR EPOXY RESINS Annual Report, Sep. 1976 - Oct. 1977
N. R. Farrar, T. W. Turner, and K. H. G. Ashbee Oct. 1977 78 p refs
(Grant DA-ERO-76-G-068)
(AD-A049796; AR-1) Avail: NTIS HC A05/MF A01 CSCL 11/4

The technique of using high intensity light emitting diodes to produce optical images of ultrasonic wave trains has been applied to two aspects of the work. In experiments preliminary to fundamental studies of resin/glass interfaces, the technique has been refined to the stage where clearly resolvable fringes can be reproducibly observed in glass and in epoxy resin, and in experiments to assess the technique's potential as a NDT tool capable of detecting flaws in real composites, ultrasound has been successfully transmitted through composite slabs to give 'readable' fringes in a glass visualising block. Accelerated water exposure tests and natural weathering tests on epoxy resin composites have continued. Chemical analysis has confirmed

the impression gained from microstructural examination of fracture surfaces that, even when apparently fully cured, these materials contain unreacted resin and hardener, dissolution of which by diffused water is no doubt partly responsible for generation of the pockets of pressure believed to be the cause of disc-shaped internal cracks. Author (GRA)

N78-21298# Naval Research Lab., Washington, D. C.
SURFACE CHEMISTRY OF FLUOROPOLYMER BARRIER FILMS: RELATION OF SOLUTION VARIABLES TO FILM PROPERTIES Interim Report
Barbara J. Kinzig and Harold Rauner 15 Nov. 1977 19 p refs
(AD-A050003; AD-E000110; NRL-8156) Avail: NTIS HC A02/MF A01 CSCL 07/4

The quality of PFOMA barrier films, e.g., thickness, smoothness, surface texture, and resistance to lubricants, is shown to depend on the formulation variables of the PFOMA-solvent solutions from which they are cast. Thus, barrier film properties can be optimized by the choice of solvent composition and concentration. Scanning electron microscopy, optical microscopy, visual observation of drying films, and contact angle measurements all showed the relation of film properties to the solution variables. This was further established by calculating solubility parameters for the compositions studied, which showed that thermodynamically good solutions formed the best barrier films. Polymer phase partitioning probably occurred in a ternary solvent mixture resulting in unusually poor films. The relation of solution thermodynamics to the film properties was the basis for selection of an optimum solvent composition. From these techniques, an optimum concentration for casting was found to be one yielding a film thickness of about 0.5 micrometers. Author (GRA)

N78-21299# Naval Surface Weapons Center, White Oak, Md. Research and Technology Dept.
TORSIONAL PENDULUM STUDY ON SEVERAL EPOXY/DIAMINE POLYMERS
G. F. Lee 31 Oct. 1977 33 p refs
(ZR00001; ZR01102)
(AD-A050478; NSWC/WOL/TR-77-162) Avail: NTIS HC A03/MF A01 CSCL 11/9

The purpose of this study is to determine the thermomechanical properties by using the torsional pendulum on the following epoxies: diglycidyl ether of bisphenol A, resorcinol diglycidyl ether, and butanediol diglycidyl ether with the following diamines propanediamine, hexanediamine, dodecanediamine, and m-phenylenediamine. There were at most three transitions in the temperature range of -150 to 200 C. The glass transition was strongly influenced by the degree of aromaticity and chain length of the amine monomers. The activation energies of the gamma transition were between 17 and 29 kcal/mole. The gamma transition which occurs at -55 C at 1 Hz, dominated the ultrasonic properties of these polymers around room temperature. The torsional pendulum was shown to be a convenient method to determine the ultrasonic properties of polymers provided the activation energies of the gamma transition are known. Author (GRA)

N78-21300# New York State Dept. of Transportation, Albany. Engineering Research and Development Bureau.
ACCEPTANCE SAMPLING OF STRUCTURAL PAINTS Interim Report
David A. Law and Gerald L. Anania May 1977 26 p refs
(PB-275757/3; NYSDOT-ERD-77-RR-53; IR-2) Avail: NTIS HC A03/MF A01 CSCL 11C

The general paint manufacturing process was briefly described. Historical data on frequency of rejections under specifications formerly in force were analyzed, resulting in some changes in those for viscosity. Current sampling plans were discussed and analyzed and a suggested revision to the container sampling scheme was presented. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N78-21301*# Martin Marietta Corp., Denver, Colo.
ANALYSIS AND TEST FOR SPACE SHUTTLE PROPELLANT DYNAMICS: 1/60TH SCALE MODEL TEST RESULTS
Robert L. Berry and James R. Tegart Mar. 1978 116 p refs (Contract NAS9-15302)
(NASA-CR-151681; MCR-78-523) Avail: NTIS HC A06/MF A01 CSCL 21I

During the abort sequence, the ET and orbiter separate under aerodynamic loading, with propellant remaining in the ET. The separation event included a seven second decelerating coast period during which the residual propellant accelerates relative to the ET/orbiter. At separation, ET clearance was primarily provided by aerodynamics acting on the ET to move it away. The motion of the propellant, primarily LOX, significantly influenced the resulting ET motion and could cause the ET to recontact the orbiter. A test program was conducted involving thirty-two drops with 1/60th scale models of the ET LOX tank. The objective was to acquire data on the nature of low g propellant reorientation, in the ET LOX tank, and to measure the forces exerted on the tank by the moving propellant. Author

N78-21302# Illinois Univ., Urbana-Champaign. Dept. of Aeronautical and Astronautical Engineering.
MODELING OF CONVECTIVE MODE COMBUSTION THROUGH GRANULATED PROPELLANT TO PREDICT TRANSITION TO DETONATION Final Report, 1 Oct. 1976 - 30 Sep. 1977
Herman Krier and James A. Kezerle Oct. 1977 106 p refs (Grant AF-AFOSR-3115-77; AF Proj. 2308)
(AD-A049499; AAE-77-17) Avail: NTIS HC A06/MF A01 CSCL 21/9

Derivation of the two-phase (reactive particle) unsteady-flow conservation equations are presented based upon the generally accepted concept of separated-flow. The resulting formulation is compared with those equations derived by others, and questions are raised as the correctness or interpretation made by previous modelers. Details of the numerical method chosen to solve these equations (an explicit two-step MacCormack scheme) are also presented. Solutions are presented that predict the pressure wave build-up and accelerating ignition (flame) front for highly loaded beds of granulated solid propellant fixed in a rigid container. Some discussion is given of the sensitivity of these predictions as a function of the assumed constitutive relations for interphase heat and momentum transfer, for particle-particle resistance, and propellant burning rate functions. As yet no unambiguous criterion for deflagration-to-detonation transition (DDT) has been presented. Author (GRA)

N78-21303# University of Southern Calif., Los Angeles. Dept. of Mechanical Engineering.
THE VAPORIZATION BEHAVIOR OF A FUEL DROP ON A HOT SURFACE Final Report, 1 May 1976 - 30 Sep. 1977
Melvin Gerstein and Mansour Nosshi Mansour Nov. 1977 122 p refs
(Grant AF-AFOSR-2876-76)
(AD-A049471; AFOSR-78-0010TR) Avail: NTIS HC A06/MF A01 CSCL 21/4

The evaporation of a fuel drop on a hot surface was investigated for a variety of pure and commercial fuels under atmospheric ambient pressure. Four basic modes of drop evaporation were identified: the contact mode, vaporization mode, maximum evaporation rate mode, and spheroidal mode. High level of experimental reproducibility was achieved for the pure fuels and the experimental variables that influenced the reproducibility of the test results were successfully identified. The effect of fuel properties on drop evaporation lifetime in the various modes of evaporation was closely examined. Fuel properties that controlled the temperature range within which the various modes of evaporation prevailed were determined. Evaporation

curves were developed for the tested fuels using a wide selection of surface conditions, some of which resembled surface characteristics encountered in actual combustion applications. The effect of the evaporating surface characteristics on evaporation lifetime was also determined. The effect of fuel additives on the evaporation behavior of fuel drop deposited on a hot surface was evaluated. GRA

N78-21304# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
AUDIBLE AND ULTRASONIC ACOUSTIC EMISSIONS FROM COMPOSITE SOLID PROPELLANTS Final Report, Oct. 1976 - Sep. 1977
William A. Bell, James I. Craig, and Warren C. Strahle Sep. 1977 70 p refs
(Grant AF-AFOSR-2805-75)
(AD-A049517; AFOSR-78-0009TR) Avail: NTIS HC A04/MF A01 CSCL 21/9

The audible and ultrasonic acoustic emissions from deflagrating composite solid propellants were monitored and analyzed to evaluate their potential use as diagnostics of the combustion and as a means for the study of fundamental burning processes. A family of composite HTPB-AP propellants were tested which include a range of AP particle sizes, aluminized and nonaluminized formulations, the effect of the addition of a catalyst, and the presence of an AFCAM aluminum coating. For the audible emissions, the frequency behavior in the 0-10 kHz range can be explained by assuming the gas phase reaction time primarily controls the oscillating frequency. The combustion noise efficiency, cannot be explained by the theories put forth, so the physical makeup of the noise source is presently unknown. Analysis of the ultrasonic emission spectra indicates that there are no distinct spectral features which can be used to identify a particular propellant by its acoustic signature. The rms emission levels, however, can be used as a reliable, nonintrusive means for detecting flaws in the propellant, identifying bad burns, and measuring burn rates. The overall level increases with increasing burn rate and chamber pressure and decreasing particle size.
Author (GRA)

N78-21305# IIT Research Inst., Chicago, Ill.
INITIATION MECHANISMS OF SOLID ROCKET PROPELLANT DETONATION Interim Report, Jul. 1976 - Oct. 1977
A. N. Takata and A. H. Wiedermann Nov. 1977 48 p refs
(Contract F44620-75-C-0059)
(AD-A049531; IITRI-J6352-2; AFOSR-78-0029TR) Avail: NTIS HC A03/MF A01 CSCL 21/8

The purpose of this study is to identify mechanisms responsible for several accidental detonations of high-energy solid rocket propellant motors. Simple models were used to predict transient gas pressures within burning propellant cracks following arrival of a step stress wave reflected by the motor case. Stress waves are considered to be caused by the propagation of a crack into the motor chamber or other cavity containing gas at much higher pressure than that initially within the crack. Two factors were found important in creating gas pressures of similar magnitude as pressures needed to initiate secondary high explosives by impact. Namely, the generation of melt or form that can be readily gasified; and the production of stress waves that initiate accelerated burning by partially collapsing cracks.
Author (GRA)

N78-21306# Army Armament Research and Development Command, Dover, N. J. Large Caliber Weapon System Lab.
COMPLEX FORMATION IN RDX, HMX, TNT, AND SOME RELATED COMPOUNDS: A BIBLIOGRAPHY
James E. Abel, Paul L. Marinkas, and S. Bulusu Dec. 1977 29 p refs
(AD-A050090; AD-E400035; ARLCD-SP-77005) Avail: NTIS HC A03/MF A01 CSCL 19/1

The complexing behavior of energetic materials has begun to emerge as a subject of importance to those involved in the formulation of explosive and propellant compositions. Casting, rheological, and detonation or burning properties of compositions can be affected by the incorporation, deliberately or accidentally, of complexes involving energetic compounds. All too often the nature of the forces which bind the components of the complex is not understood, and cannot be exploited. This bibliography gathers together the known literature references to complexes involving RDX, HMX, and TNT, as well as some related nitramines and nitroaromatics. Because the suspicion exists that crystals of RDX and HMX are at least partially bound together by charge-transfer complexing forces, references to the known crystal structures of the RDX, HMX, and TNT polymorphs are included. In recent years the crystal structures of some of the intermediates in RDX and HMX synthesis have been determined, and references to these structures are also included. Author (GRA)

N78-21307# Aeronautical Research Associates of Princeton, Inc., N. J.
A REACTING TURBULENT BOUNDARY LAYER APPROACH TO SOLID PROPELLANT EROSIVE BURNING Final Scientific Report, 1 Oct. 1976 - 30 Sep. 1977
Robert A. Beddini Nov. 1977 46 p refs
(Contract F44620-76-C-0016; AF Proj. 2308)
(AD-A049537; ARAP-319; AFOSR-77-1310TR) Avail: NTIS HC A03/MF A01 CSCL 21/2

A theoretical analysis of the erosive burning of solid propellants is presented using a reacting turbulent boundary layer approach. The turbulent field is modeled using the second-order closure technique and a single-step gas-phase reaction is assumed for the combustion of a homogeneous propellant. The calculated results agree with the generally observed erosive burning trends of threshold velocity, nonlinear recession-ratio velocity dependence, pressure dependence, and normal burning rate sensitivity. For constant external velocity boundary layers, the results show a decrease in burning rate along the propellant surface, which also has been observed experimentally. Examination of calculated profiles of temperature and turbulent correlations in the boundary layer reveals that erosive burning is predominantly caused by flame zone broadening due to the diffusive effects of turbulence.
Author (GRA)

N78-21308# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
PROPELLANT BURNING RATE AND COMBUSTION UNIFORMITY IDENTIFIED BY ULTRASONIC ACOUSTIC EMISSIONS Final Report, 1 Mar. 1974 - 1 Aug. 1975
L. H. Caveny, A. J. Saber, and M. Summerfield Jan. 1976 48 p refs
(Contract DAAA21-74-C-0332)
(AD-A049942; AMS-1302) Avail: NTIS HC A03/MF A01 CSCL 19/1

A new method of measuring the burning rate of as-manufactured grains of nitrocellulose-based propellants was developed. Chamber pressurization to 50,000 psi (3400 atm) was achieved using a hydraulic pump, rather than a nitrogen intensifier system; the burning interval was monitored by recording the acoustic emission from the burning propellant. Burning rate variations of nitrocellulose-based propellants (M1 and M26), burning at pressures between 10,000 and 40,000 psi, were recognized by examining the level of the combustion-generated acoustic emissions. GRA

N78-21309# Atlantic Research Corp., Alexandria, Va.
SAFETY EVALUATION OF DISTRESS FLARES AND SMOKES Final Report, Jun. - Nov. 1977
Edward T. McHale Nov. 1977 32 p refs
(Contract DOT-CG-74132-A)
(AD-A049969; ARC-47-6102; USCG-D-89-77) Avail: NTIS HC A03/MF A01 CSCL 19/1

An evaluation program was conducted for the purpose of uncovering any safety hazards that might be associated with the use of distress flares and smokes, particularly those hazards that would pertain to the use of the devices by the public on recreational boats. Devices tested included hand-held flares and smokes, self-contained and pistol-launched meteors and parachute flares, and floating smokes. Testing was performed to assess hazards of: spattering and slag dripping on personnel, on materials, and on ignition of exposed liquid fuel; toxicity of smoke or other combustion products; heatup of casing or hardware parts; recoil from self-contained or pistol-fired flares. Additionally, several performance criteria were analyzed: burn time, intensity, effect of aging, failure rate, ease of use, and altitude attained by launched flares. The principal safety problems that were exposed involved:

(1) the tendency of slag to drip from hand-held flares and to ignite many types of materials that it falls onto; (2) possible toxicity of products of orange smokes; (3) excessive failure and significant recoil of certain pistol-fired parachute flares. The overall failure rate of all units tested in the course of the project was six percent (not counting pistol-fired parachute flares).
Author (GRA)

N78-21310# Martin Marietta Labs., Baltimore, Md.
COMBUSTION PROPERTIES OF HIGH DENSITY FUELS Final Report, 1 Nov. 1976 - 31 Oct. 1977
John M. Brupbacher and M. Thomas McCall Nov. 1977 35 p refs
(Contract N00019-76-C-0683)
(AD-A050051; MML-TR-77-72C) Avail: NTIS HC A03/MF A01 CSCL 21/9

A novel experimental technique has been developed to simulate combustion of liquid propellants in rocket engines. The method uses an ultrasonic nebulizer coupled to the downstream end of a shock tube, which is equipped with visible, infrared, and pneumatic monitoring devices. This system was used to initiate RJ-5 mist combustion in oxygen at around 1500 K with an associated reflected shock pressure of about 2 atm. Under these conditions, the ignition delay of RJ-5 droplets with a mean particle diameter of about 3 micron was 200 micro sec, whereas ignition delay of RJ-5 vapor in the same experiment was very short (less than 1 micro sec). The droplet ignition delay decreased with increasing temperature and was approximately 100 micro sec at 1700 K. Author (GRA)

N78-21311# Princeton Univ., N. J. Guggenheim Aerospace Propulsion Labs.
OXIDATION KINETICS OF HYDROCARBON FUELS Final Report, 1 Oct. 1973 - 30 Sep. 1977
Irvin Glassman, Frederick L. Dryer, and Robert J. Santoro Dec. 1977 48 p refs
(Grant AF-AFOSR-2604-74)
(AD-A050056; AMS-1359; AFOSR-78-0061TR) Avail: NTIS HC A03/MF A01 CSCL 07/3

This report discusses interim results on the elucidation of high temperature oxidation kinetics of hydrocarbon fuels through experimental studies in a turbulent flow reactor. The report details current results particularly on ethane oxidation. Also discussed are results of an exploratory study of low pressure metal/oxidizer flame systems as a source of chemical laser action.
Author (GRA)

N78-21312# National Oceanic and Atmospheric Administration, Boulder, Colo. Marine Ecosystems Analysis Program Office.
CHEMICAL AND PHYSICAL PROPERTIES OF REFINED PETROLEUM PRODUCTS
Herbert Curl, Jr. and Kevin ODonnell Oct. 1977 36 p
(PB-277100/4; NOAA-TM-ERL-MESA-17; NOAA-77122003) Avail: NTIS HC A03/MF A01 CSCL 21D

No exact numbers were given for solubilities of fuel oil in water because the composition of a fuel oil varies from one refinery to another. Hydrocarbons of a lower molecular weight were more soluble than those of a higher molecular weight. Under normal conditions of wind, waves and temperature on an open sea, the evaporation rate of spilled oil was quite significant. The most toxic components of fuel oils were the aromatics which are relatively highly soluble in water. Of the various fuels, the most toxic was probably gasoline because of its high content of aromatics and other low-boiling hydrocarbons. GRA

N78-21313# General Accounting Office, Washington, D. C. Energy and Minerals Div.
EMERGENCY NATURAL GAS PURCHASES: ACTIONS NEEDED TO CORRECT PROGRAM ABUSES AND CONSUMER INEQUITIES
6 Jan. 1978 48 p
(PB-275876/1; EMD-78-10) Avail: NTIS HC A03/MF A01 CSCL 10A

Discussion is presented for improvements needed in the Federal regulation of natural gas obtained under emergency provisions to prevent its use counter to national conservation policies and to prevent the higher costs of natural gas so purchased from being borne inequitably. The report contains recommendations for consideration by the Congress. GRA

N78-21314# National Highway Traffic Safety Administration, Washington, D. C. Office of Program Analysis, Planning and Evaluation.
THE AUTOMOTIVE FUEL ECONOMY STANDARDS FOR MODEL YEAR 1981-1984 PASSENGER CARS Final Report
30 Jun. 1977 141 p refs
(PB-275827/4; DOT-HS-803-183) Avail: NTIS HC A07/MF A01 CSCL 10A

Various micro- and macroeconomic impacts of the average fuel economy standards for model year 1981-84 passenger cars were evaluated. Such microeconomic impacts as cost and price changes for both the domestic manufacturers and the consumer were analyzed. Also examined were such macroeconomic impacts as employment, energy consumption and G.N.P. GRA

N78-21315# National Highway Traffic Safety Administration, Washington, D. C. Office of Automotive Fuel Economy.
RULEMAKING SUPPORT PAPER CONCERNING THE 1981-1984 PASSENGER AUTO AVERAGE FUEL ECONOMY STANDARDS
Jul. 1977 223 p refs
(PB-275895/1; DOT-HS-803-184) Avail: NTIS HC A10/MF A01 CSCL 10A

The automobile industry's ability to produce more fuel efficient automobiles in the 1981-1984 time frame is assessed. The assessment included the following considerations: technology feasibility, economic practicability, effect of other Federal standards, and the need of the nation to conserve fuel. This assessment indicated that the manufacturers could achieve average fuel economy standards of 22 mpg in 1981, 24 mpg in 1982, 26 mpg in 1983 and 27 mpg in 1984. GRA

N78-21316# Lummus Co., New York.
PROTOTYPE PILOT PLANT OPERATION: SYNTHANE PROCESS Contractor Quarterly Operation Report No. 11, 1 Apr. - 30 Jun. 1977
Oct. 1977 15 p
(Contract EY-76-C-02-0003)
(COO-0003-8) Avail: NTIS HC A02/MF A01

During the run period, gas was produced for 76 hours. Feed rates and bed heights were varied at operating temperatures of 1500 F in an attempt to achieve over 70% carbon conversion. During other runs, emphasis was placed on attempting to make the internal cyclone operate. During these runs, considerable improvement was noted in the solids carryover into gas scrubbing. The fines return to the bed resulted in much lower densities and poor bed level control was experienced. The gasifier was operated for a period of eight days at varying conditions, in an attempt to achieve better operability with the low bed densities. ERA

N78-21317# Lummus Co., Bloomfield, N. J.
PROTOTYPE PILOT PLANT OPERATION, SYNTHANE PROCESS Contractor Monthly Activity Report No. 36, 1-31 Aug. 1977
Sep. 1977 14 p
(Contract EY-76-C-02-0003)
(COO-0003-10) Avail: NTIS HC A02/MF A01

During the operation period, oxygen and coal were fed for 190 hours, 98 hours of which were without interruption. The run produced ten steady state periods. Bed temperatures and feed rates were varied to study the effect of these variables on conversions. Carbon conversions of 75 percent to 78 percent were achieved for extended periods of operation of feed rates of 2 to 3 tons per hour. The successful completion of this run finishes studies of Western subbituminous coal. ERA

N78-21318# Energy Research and Development Administration, Washington, D. C.
LOW-Btu COAL GASIFICATION
Aug. 1977 11 p
(ERHQ-0015) Avail: NTIS HC A02/MF A01

The evaluation of technical and economical integration of low Btu coal gasification technology in various operational

environments was studied. The projects were to be limited to 8 t/hr capacity and only state of the art technologies were to be used. Projects were selected on the basis of overall technical feasibility, financial contribution by the participants, qualifications of the offerer and partners, ability to finance, total cost of the projects, application, and type of gasifiers. The projects include the use of anthracite coal as well as low and high sulfur bituminous coals. Also included were one and two stage gasifiers, oil, and tar removal and reuse, and secondary systems for sulfur removal from the product gas. ERA

N78-21319# Dynatech R/D Co., Cambridge, Mass.
INVESTIGATION OF CONVERTING THE PRODUCT OF COAL GASIFICATION TO METHANE BY THE ACTION OF MICROORGANISMS, PHASE 1 Quarterly Report, 1 Sep. - 1 Dec. 1976
Don C. Augenstein and Donald L. Wise 15 Dec. 1977 54 p
(Contract EX-76-C-01-2203)
(FE-2203-16; Rept-1559; QR-4) Avail: NTIS HC A04/MF A01

The principal experimental objectives were to increase productivity through thermophilic operation in conjunction with recycle, to demonstrate high pressure, high-rate, thermophilic operation with recycle, and to demonstrate the practical biological shift conversion of carbon monoxide. Thermophilic operation with recycle has resulted in the highest productivities obtained to date. High productivities were delivered in thermophilic pressure fermentations to 120 psig with recycle. Encouragingly rapid rates of CO conversion were obtained in initial trials utilizing a new organism and medium; an initial shift rate and hydrogen productivity were attained. In trials to establish the sensitivity of the thermophilic culture to hydrogen sulfide, no inhibition of culture productivity was seen at hydrogen sulfide concentrations as high as 10 percent in the test gas mix. ERA

N78-21320# Dow Chemical Co., Midland, Mich.
CHEMICALS FROM COAL: USBM SYNTHOIL Interim Report
Bruce C. Peters Oct. 1977 88 p ref
(Contract EX-76-C-01-1534)
(FE-1534-49) Avail: NTIS HC A05/MF A01

Laboratory studies in metal reactors and computer and mathematical simulations were performed to provide overall material balance data for a conceptual plant. The mid-distillate was hydrocracked to produce naphtha which was further processed by hydrotreating and reforming. The reformate from the mid-distillate was then mathematically hydrodealkylated to convert it to a product slate consisting of methane, liquefied petroleum gases, benzene, and fuel, along with the total hydrogen consumed. The high aromatic yield obtained from the hydrocrackate naphtha makes this fraction very attractive as a petrochemical feedstock. ERA

N78-21321# Dynatech R/D Co., Cambridge, Mass.
FUEL GAS PRODUCTION FROM ANIMAL WASTE, PHASE 1 Annual Summary Report, 17 May 1976 - 17 May 1977
E. Ashare, R. L. Wentworth, D. L. Wise, and D. C. Augenstein 31 May 1977 30 p refs
(Contract EY-76-C-02-2991)
(COO-2991-17) Avail: NTIS HC A03/MF A01

An engineering and economic analysis was performed for an anaerobic digestion process for the production of fuel gas from animal wastes. A comprehensive engineering report was prepared describing this study. A study of processes for the removal of acid gases from digester gas was initiated to review the technology and assess the technical and economic feasibility of gas scrubbing technology for removal of CO2 from digester gas. ERA

N78-21322# California Univ., Livermore. Lawrence Livermore Lab.
ALTERNATIVE FUELS FOR TRANSPORTATION: IMPLICATIONS OF THE BROAD-CUT OPTION
C. J. Anderson 11 Jul. 1977 18 p refs
(Contract W-7405-eng-48)
(UCRL-52313) Avail: NTIS HC A02/MF A01

Broad-cut liquid hydrocarbon fuels could lead to important fuel savings through more efficient engines and fuel production. Broad-cut fuels could be made initially from petroleum and ultimately from coal, oil shale, or other economical sources. Engines designed for the fuels might include direct-injected, stratified, turbine, stirling, or spark-assisted diesel engines. ERA

N78-21323# Ad Hoc Committee on the Use of Hydrogen as a Supplement to Natural Gas.
EVALUATION OF THE USE OF HYDROGEN AS A SUPPLEMENT TO NATURAL GAS
Jun. 1977 72 p Prepared for DOE
(TID-27747) Avail: NTIS HC A04/MF A01

The potential for mid-term (1985-2000) commercial application of the use of hydrogen for blending into the present natural gas delivery system as an energy supplement was studied. Successful development of advanced electrolyzer technology and availability of low-cost off-peak and spinning reserve electric-generating capacity are basic to this concept. Because no source was found that would make such a concept economically viable in the near future, a major, federally funded R, D, and D program aimed at proving the technical feasibility is not justified within the next five years. No overriding environmental, safety, legal, code, or regulatory considerations were found that would preclude the hydrogen-natural gas supplementation concept. Fostering of long-term research activities for hydrogen production using gas electrolysis is recommended in connection with other prospective end uses. ERA

N78-21324# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.
DIESEL FUEL OILS, 1977
Ella Mae Shelton Nov. 1977 37 p refs
(BERC/PPS-77/5) Avail: NTIS HC A03/MF A01

Tests of 215 samples of diesel fuel oils from 100 refineries throughout the country were made by 31 petroleum refining companies. The analyses of the fuels are listed in tables for four groups according to type of diesel fuel. Each group of analyses is subdivided into five tabulations according to five general regions of the country where the fuels are marketed. The regions, containing a total of 16 districts, are shown on a map in the report. A total of 13 laboratory tests are listed and arranged by geographic marketing districts in decreasing order of sales volumes. Charts are included showing trends of averages of certain properties for the four types of diesel fuels. ERA

N78-21325# Radian Corp., Austin, Tex.
ENVIRONMENTAL ASSESSMENT OF LOW/MEDIUM BTU GASIFICATION Annual Report, Mar. 1976 - Oct. 1977
E. C. Cavanaugh and W. C. Thomas Dec. 1977 35 p
(Contract EPA-68-02-2147)
(PB-276580/8; EPA-600/7-77-142) Avail: NTIS HC A03/MF A01 CSCL 07A

Main areas discussed are the current process technology background, environmental data acquisition, and control technology assessment. Information presented gives a general understanding of what has been accomplished and what can be anticipated. GRA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N78-21326*# Michigan Univ., Ann Arbor. Dept. of Applied Mechanics and Engineering Science.
DEFINITION OF TIRE PROPERTIES REQUIRED FOR LANDING SYSTEM ANALYSIS Final Report
S. K. Clark, R. N. Dodge, and J. R. Luchini Mar. 1978 26 p
(Grant NsG-1080)
(NASA-CR-156171; UMICH-012881) Avail: NTIS HC A03/MF A01 CSCL 14D

The data bank constructed provided two basic advantages for the user of aircraft tire information. First, computerization of the data bank allowed mechanical property data to be stored, corrected, updated, and revised quickly and easily as more reliable tests and measurements were carried out. Secondly, the format

of the book which can be printed from the computerized data bank can be easily adjusted to suit the needs of the users without the great expense normally associated with reprinting and editing books set by ordinary typography. Author

N78-21327# New Jersey State Dept. of Transportation, Trenton. Div. of Research and Development.
PAVEMENT HEATING: EXECUTIVE SUMMARY Final Report
Frank Winters and S. Robert Sasor Feb. 1977 33 p Sponsored in part by DOT
(PB-276504/8; Rept-77-003A-7722; FHWA/NJ-77-003A) Avail: NTIS HC A03/MF A01 CSCL 13B

Heat was extracted from the earth by means of a grid of pipes buried 3 to 13 ft. below ground and transferred via an ethylene glycol-water solution to pipes embedded in a test pavement. For purposes of comparison, a section of pavement heated by electrical resistance wires was also included as part of the installation. Results of operation indicated that the best snow melting took place on sections of portland cement concrete containing 3/4 inch and 1-1/4 inch wrought iron pipe spaced on 6 inch centers and embedded at a depth of 12 inches. GRA

N78-21328# Transport and Road Research Lab., Crowthorne (England).
THE USE OF SATELLITE IMAGERY FOR HIGHWAY ENGINEERING IN OVERSEAS COUNTRIES
P. J. Beaven and T. E. Beaumont 1977 26 p refs Presented at the British Interplanetary Soc. Meeting, London, 22-23 Sep. 1976
(PB-276669/9; TRRL-Supplementary-279; ISSN-0305-1315) Avail: NTIS HC A03/MF A01 CSCL 13B

LANDSAT imagery was used on two road investigations to provide information on the four main factors that affect route location. The interpretation techniques included the production and enhancement of color composites in a purpose built additive viewer which was also used for examining photographically prepared density slices of infrared band 7 imagery. The work was used to define the main techniques that can be employed and to identify the major areas where satellite imagery could assist the highway engineer. It was concluded that the present generation of imagery is most suited for the planning and feasibility stages of engineering survey for road projects. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking*.

N78-21329 Missouri Univ., Rolla.
SIGNAL-TO-NOISE RATIO ESTIMATION IN DIGITAL COMPUTER SIMULATION OF LOWPASS AND BANDPASS SYSTEMS WITH APPLICATIONS TO ANALOG AND DIGITAL COMMUNICATIONS Ph.D. Thesis
Michael David Turner 1977 237 p
Avail: Univ. Microfilms Order No. 78-01702

Techniques were developed to estimate power, gain, delay, signal-to-noise ratio, and mean-square error in digital computer simulations of lowpass and bandpass systems. The techniques were applied to analog and digital communications. The signal-to-noise ratio estimates were shown to be maximum likelihood estimates in additive white Gaussian noise. The methods were seen to be especially useful for digital communication systems where the mapping from the signal-to-noise ratio to the error probability can be obtained. Simulation results showed the techniques developed to be accurate and quite versatile in evaluating the performance of many systems through digital computer simulation. Dissert. Abstr.

N78-21330 Japan Broadcasting Corp., Tokyo. Broadcasting Science Research Labs.
MULTICHANNEL STILL-PICTURE TRANSMISSION SYSTEM: TDM TRANSMISSION OF DELTA-M SOUNDS WITH STILL-PICTURE IN TELEVISION CHANNEL
Takehiko Yoshino, Akio Yanagimachi, and Seizo Tamai Aug. 1977 16 p refs
(NHK-Labs-Note-214) Copyright. Avail: Issuing Activity

Still picture broadcasting which transmits simultaneously many programs consisting of color still pictures with accompanying sound by exclusive use of a television channel has been proposed as a new form of broadcasting. A multichannel still picture transmission system was designed which transmits delta-M sound signals with picture signals in the time division multiplexing form. From the results obtained in laboratory experiments, the system is expected to be compatible with current television networks. Author

N78-21331 Japan Broadcasting Corp., Tokyo. Broadcasting Science Research Labs.
MINIATURE STEREOMICROPHONE
Akio Mizoguchi and Mitsuru Ichikawa Jul. 1977 12 p
(NHK-Labs-Note-213) Copyright. Avail: Issuing Activity

The most important problem in miniaturizing the condenser microphone is to miniaturize its diaphragm, which determines the dimension of its transducer. The ideal is, of course, to have a diaphragm of minimum dimensions but still giving the desired quality of performance. To achieve this goal, a practical design was developed for a miniature stereomicrophone. Adoption of a push-pull transducing system has enabled considerable miniaturization of microphone dimensions with satisfactory performance for stereophonic pickup. Author

N78-21332 British Broadcasting Corp., Kingswood (England). Engineering Div.
COMPUTATION OF GROUNDWAVE ATTENUATION OVER IRREGULAR AND INHOMOGENEOUS GROUND AT LOW AND MEDIUM FREQUENCIES
G. D. Monteath Mar. 1978 21 p refs
(BBC-RD-1978/7) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

A computer program was written to calculate groundwave field strength at low and medium frequencies. Account is taken of arbitrary variation of the ground constants and the height above sea level along the path of propagation. A variety of tests show the program to be fast and the results accurate. The results confirm the widely held belief that departure of the surface from a smooth sphere is not usually very important in terrain that is not mountainous. Nevertheless, a useful gain in groundwave field strength can result from siting a transmitter on high ground. Author

N78-21333*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LARGE ACTIVE RETRODIRECTIVE ARRAYS FOR SPACE APPLICATIONS
R. C. Chernoff 15 Jan. 1978 59 p refs
(Contract NAS7-100)
(NASA-CR-156163; JPL-Pub-78-20) Avail: NTIS HC A04/MF A01 CSCL 20N

An active retrodirective array (ARA) electronically points a microwave beam back at the apparent source of an incident pilot signal. Retrodirectivity is the result of phase conjugation of the pilot signal received by each element of the array. The problem of supplying the correct phase reference to the phase conjugation circuit (PCC) associated with each element of the array is solved by central phasing. By eliminating the need for structural rigidity, central phasing confers a decisive advantage on ARA's as large spaceborne antennas. A new form of central phasing suitable for very large arrays is described. ARA's may easily be modified to serve both as transmitting and receiving arrays simultaneously. Two new kinds of exact, frequency translating PCC's are described. Such PCC's provide the ARA with input-output isolation and freedom from squint. The pointing errors caused by the radial and transverse components of the ARA's velocity, by the propagation medium, and by multipath are discussed. A two element ARA breadboard was built and tested at JPL. Its performance is limited primarily by multipath induced errors. Author

N78-21334# Communications Research Centre, Ottawa (Ontario).

IONOSPHERIC EFFECTS ON THE DOPPLER FREQUENCY SHIFT IN SARSAT PROPAGATION
D. B. Muldrew and H. G. James Feb. 1978 43 p refs
(CRC-1313) Avail: NTIS HC A03/MF A01

Ionospheric effects were estimated for a proof of concept SARSAT experiment using the AMSAT OSCAR-6 satellite. In this case, the down link was at 30 MHz and the daytime ionosphere with no horizontal gradients in electron density can change the Doppler frequency by a few hertz. Horizontal gradients of electron density can have more effect on the Doppler frequency than the vertical distribution of density since the negative vertical density gradient in the topside ionosphere tends to compensate the Doppler effect due to the positive gradient in the bottomside. In the late afternoon, evening and nighttime, large east-west troughs in the density distribution exist which can produce shifts of a few tens of hertz at 30 MHz. The Doppler frequency shift due to the ionosphere varies approximately inversely as the frequency. Author

N78-21335# Electromagnetic Compatibility Analysis Center, Annapolis, Md.
TARGET ACQUISITION CONTOURS GENERATED FOR RCAG/BUEC SITES IN THE CONTIGUOUS UNITED STATES Final Report
E. Wayne Bunk (IIT Res. Inst., Annapolis) Nov. 1977 30 p ref
(Contracts DOT-FA76WAI-612; F19628-78-C-0006; AF Proj. 649E)
(AD-A050978; ECAC-PR-77-049; FAA-RD-77-126) Avail: NTIS HC A03/MF A01 CSCL 17/2

The program, procedures, and parameters used in the production of target acquisition contour overlays are documented. These overlays, of the Remote Communications Air/Ground and Backup Emergency Communications sites in the contiguous United States, were produced for the FAA. Author

N78-21336*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
A DEPOLARIZATION AND ATTENUATION EXPERIMENT USING THE COMSTAR AND CTS SATELLITES Final Report, 1 Oct. 1976 - 30 Sep. 1977
C. W. Bostian, S. R. Kauffman, E. A. Manus, R. E. Marshall, W. P. Overstreet, R. R. Persinger, W. L. Stutzman, and P. H. Wiley 9 Feb. 1978 125 p refs
(Contract NAS5-22577)
(NASA-CR-156730) Avail: NTIS HC A06/MF A01 CSCL 20N

An experiment for measuring precipitation attenuation and depolarization on the CTS 11.7 and the COMSTAR 19.04 and 28.56 GHz downlinks is described. Attenuation scaling, effective path length, and the relationship between isolation and attenuation are discussed. Attenuation and effective path data are presented for the months of July, August, and September, 1977. Author

N78-21337*# Ohio State Univ., Columbus. ElectroScience Lab.
AN ANALYSIS OF MULTI-FREQUENCY HIGH RESOLUTION RADAR RAIN RATE DATA Final Report
D. M. J. Devasirvatham Dec. 1977 26 p refs
(Contract NAS5-23850)
(NASA-CR-156734; ESL-784650-3) Avail: NTIS HC A03/MF A01 CSCL 17I

Approximately 100,000 records of data at 3.05, 9.35, and 15.56 GHz, each set associated with a single look angle, are edited and analyzed to determine the characteristic dimensions of the rain cells observed and the rain rate distributions within these cells. The results, consistent with earlier results, demonstrate the feasibility of using attenuating frequency radars for high resolution rain rate measurements. Author

N78-21338*# Lockheed Electronics Co., Houston, Tex. Spacecraft Systems Test Section.
ORBITER S-BAND FM SYSTEM CONSOLE TEST PROCEDURE
G. D. Doland Feb. 1978 41 p
(Contract NAS9-15200)
(NASA-CR-151694; LEC-11783) Avail: NTIS HC A03/MF A01 CSCL 17B

The S-band frequency modulated system console is described and step by step test procedure for verifying proper construction of the console prior to installation of flight equipment was given. Author

N78-21339*# Texas A&M Univ., College Station. Remote Sensing Center.
ANALYSIS OF SYNTHETIC APERTURE RADAR IMAGERY Final Report, May 1976 - Jun. 1977
Bruce J. Blanchard 10 Jun. 1977 40 p refs
(Contract NAS5-23458)
(NASA-CR-156743; RSC-3359-2) Avail: NTIS HC A03/MF A01 CSCL 17I

Some problems faced in applications of radar measurements in hydrology are: (1) adequate calibration of the radar systems and direct digital data will be required in order that repeatable data can be acquired for hydrologic applications; (2) quantitative hydrologic research on a large scale will be prohibitive with aircraft mounted synthetic aperture radar systems due to the system geometry; (3) spacecraft platforms appear to be the best platforms for radar systems when conducting research over watersheds larger than a few square kilometers; (4) experimental radar systems should be designed to avoid use of radomes; and (5) cross polarized X and L band data seem to discriminate between good and poor hydrologic cover better than like polarized data. Author

N78-21340# Softech, Inc., Waltham, Mass.
COMMUNICATIONS HIGH-ORDER LANGUAGE INVESTIGATION, VOLUME 1 Interim Report, 1 Jun. 1976 - 30 Jun. 1977
R. S. Eanes, J. B. Goodenough, J. R. Kelly, D. K. Klotzbach, and A. J. Nickelson Griffiss AFB, N. Y. RADC Oct. 1977 233 p 2 Vol.
(Contract F30602-76-C-0306)
(AD-A049737; RADC-TR-77-341-Vol-1) Avail: NTIS HC A11/MF A01 CSCL 09/2

This report contains data and conclusions that were used in selecting JOVIAL J73I as a base language for modifications that would result in a language suitable for programming communications applications. Volume I of this report contains a description of the process used to develop hypotheses on what features are required of a language suitable for programming communications applications. This volume also contains rationale for selection of JOVIAL/J73I, efficiency requirements and results of a questionnaire concerning high-order languages and communications. GRA

N78-21341# Softech, Inc., Waltham, Mass.
COMMUNICATIONS HIGH-ORDER LANGUAGE INVESTIGATION, VOLUME 2 Interim Report, 1 Jun. 1976 - 30 Jun. 1977
R. S. Eanes, J. B. Goodenough, J. R. Kelly, D. K. Klotzbach, and A. J. Nickelson Griffiss AFB, N. Y. RADC Oct. 1977 450 p refs 2 Vol.
(Contract F30602-76-C-0306)
(AD-A049736; RADC-TR-77-341-Vol-2) Avail: NTIS HC A19/MF A01 CSCL 09/2

This report contains data and conclusions that were used in selecting JOVIAL J73I as a base language for modifications that would result in a language suitable for programming communications applications. Volume 1 of this report contains a description of the process used to develop hypotheses on what features are required of a language suitable for programming communications applications. Volume 2 of this report contains an extensive features list showing the presence or absence of specific features from each of the 5 languages evaluated -- CS4, JOVIAL (both J3 and J73), PASCAL and PL/I. GRA

N78-21342# Auburn Univ., Ala. Engineering Experiment Station.
TRANSIENT ANALYSIS OF A FINITE LENGTH CYLINDRICAL SCATTERER VERY NEAR A PERFECTLY CONDUCTING GROUND, PART 1 Final Report
T. H. Shumpert Nov. 1977 104 p refs 2 Vol.
(Contract F44620-76-C-0054; AF Proj. 2301)
(AD-A050143; AFOSR-78-0101TR) Avail: NTIS HC A06/MF A01 CSCL 20/3

In attempting to model and predict the magnitude of the surface currents induced on aircraft in the ground-alert mode, it is necessary to examine the effects of the near proximity of the earth's surface. For thin cylindrical scatterers sufficiently far removed (several wavelengths) from the surface, these effects may be taken into account with filamentary currents on the scatterer and its image. However, if the scatterer is moved very near (a fraction of a wavelength) to the ground, the assumption of filamentary currents is invalidated. In this note a transmission line mode approximation is used to model the circumferential variations of the surface current induced on a finite length cylindrical scatterer very near a perfect ground. This solution is compared to previous solutions based on filamentary currents. The results give clear indications as to when the more sophisticated approach should be used to obtain valid solutions to the scattering problems of this type. Author (GRA)

N78-21343# Auburn Univ., Ala. Engineering Experiment Station.

TRANSIENT ANALYSIS OF A FINITE LENGTH CYLINDRICAL SCATTERER VERY NEAR A PERFECTLY CONDUCTING GROUND, PART 2 Final Report

T. H. Shumpert Nov. 1977 65 p refs 2 Vol.

(Contract F44620-76-C-0054; AF Proj. 2301)

(AD-A050144; AFOSR-78-0101TR-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 20/3

For abstract, see N78-21342.

N78-21344# Sachs/Freeman Associates, Inc., Hyattsville, Md.

IEMCAP IMPLEMENTATION STUDY, VOLUME 1 Final Technical Report

E. Freeman Griffiss AFB, N. Y. RADC Dec. 1977 64 p refs 2 Vol.

(Contract F30602-76-C-0356)

(AD-A049739; RADC-TR-77-376-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 20/3

This report addresses the need for an intrasystem analysis in the development of a new or modified weapon system. A survey was first performed to determine the current implementation of the EMC process in a weapon system's development. The results of this survey are presented. The economics of using a computerized intrasystem analysis was also examined. This report covers the costs associated with installing and using an analysis system and the cost reduction benefits derived from its utilization. The five phases of the acquisition life cycle are also examined with recommendations made concerning the extent of intrasystem analysis appropriate for each. Author (GRA)

N78-21345# Syracuse Univ., N. Y.

EXPERIMENTAL VALIDATION OF THE ANTENNA PATTERN DISTORTION COMPUTER PROGRAM, VHF ANTENNA

Jose Moses Perini and Hubert Moses Griffiss AFB, N. Y. RADC Dec. 1977 58 p

(Contract F30602-75-C-0121)

(AD-A049740; RADC-TR-77-374) Avail: NTIS HC A04/MF A01 CSCL 20/3

The Antenna Pattern Distortion Computer Program was written at the request of AFCS to evaluate the distortion on the radiation pattern of communication antennas when mounted in close proximity to each other, such as in the communication towers of many AF installations. Although the numerical method used in this computer program (Method of Moments) has been shown to be very accurate in many applications, it was felt desirable to verify it with an experimental validation study. This was done at the RADC anechoic chamber. The first phase of the validation was for the VHF antenna AN1181. In view of the fact that the actual frequency range of this antenna (100-156 MHz) is below that of the RADC anechoic chamber, it was necessary to build a scale model of the antenna. This report presents a description of the measurement procedure, the results and a comparison with the corresponding Antenna Pattern Distortion Computer Program runs. GRA

N78-21346# Raytheon Co., Wayland, Mass.

UNATTENDED/MINIMALLY ATTENDED RADAR STUDY. VOLUME 1: SUMMARY Final Technical Report

A. W. Grench and J. L. Berube Griffiss AFB, N. Y. RADC Dec. 1977 31 p 2 Vol.

(Contract F30602-76-C-0389)

(AD-A049776; ER77-4109-Vol-1; RADC-TR-77-401-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 17/9

The technical summary is a synopsis of the Unattended/Minimally Attended Radar Study to investigate the exploratory and advance development activities necessary to support the development of unattended and minimally attended radars. The study looked at several radar designs. The primary considerations were high reliability and low-life cycle cost, with the additional constraint that the unattended radars were to use no more than approximately 500 W of prime power. The conclusion of the study is that the technology is potentially available to build radars with MTBF's, an order of magnitude greater than that exhibited by present radar systems. Author (GRA)

N78-21347# Raytheon Co., Wayland, Mass.

UNATTENDED/MINIMALLY ATTENDED RADAR STUDY, VOLUME 2 Final Technical Report

A. W. French and J. L. Berube Griffiss AFB, N. Y. RADC Dec. 1977 415 p refs 2 Vol.

(Contract F30602-76-C-0389)

(AD-A049777; ER77-4109-Vol-2; RADC-TR-77-401-Vol-2) Avail: NTIS HC A18/MF A01 CSCL 17/9

This report presents results of a study of alternative radar design approaches that could be developed to optimally satisfy requirements for unattended and minimally attended radar operations. The requirements, detailed in the study statement of work, consist of two sets of nominal radar performance parameter goals; one set for the unattended radar (Type A) and a second for the minimally attended radar (Type B). Based on these requirements, alternative radar design approaches were synthesized for the Type A and evaluated for reliability, life cycle cost (LCC) and performance. A preferred design approach for a Type B radar is presented along with rationale by which the preferred choice evolved. Author (GRA)

N78-21348# Naval Research Lab., Washington, D. C. Radar Analysis Staff.

RANGE RESOLUTION OF TARGETS USING AUTOMATIC DETECTORS

G. V. Truck 28 Nov. 1977 20 p

(RR0140941)

(AD-A049442; AD-E000075) Avail: NTIS HC A02/MF A01 CSCL 17/9

When two targets are closely separated in range, automatic detectors will declare the presence of only one target. To increase the probability of resolving targets in range, log video should be used and the threshold should be of the form $T = mu + F$, where the mean mu is the smaller of the two means calculated from a number of reference cells on either the greater range side of the test cell or the lesser range side, and F is a fixed number. When the adjacent detection merging algorithm (which decides that detections at the same azimuth and elevation in adjacent range resolution cells are from the same target) is used, the probability of resolving targets does not rise above 0.9 until the targets are separated in range by 2.5 pulse widths. Author

N78-21349# Science Applications, Inc., Berkeley, Calif.

NUMERICAL RESULTS FOR MULTICONDUCTOR TRANSMISSION LINE NETWORKS Final Report

C. E. Raum, T. K. Liu, F. M. Tesche, and S. K. Chang Nov. 1977 47 p refs

(Contract F29601-76-C-0125)

(AD-A049451; AFWL-TR-77-123) Avail: NTIS HC A03/MF A01 CSCL 09/5

This report describes the algorithms and numerical results for a lossless multiconductor transmission-line network which is excited by a number of lumped voltage and current sources located on the transmission lines. As opposed to previous analyses of multiconductor transmission lines, the method described in this report is capable of treating networks which contain one or more closed transmission- line loops. The formulation of this analysis involves defining a large matrix equation (the BLT equation for currents incident on each of the junctions of the transmission-line network. Matrix inversion then provides the solution for these incident currents, with the reflected current component then being determined from knowledge of the scattering properties of the junctions. The total junction currents are then found by combining

the incident and reflected components. To illustrate this approach, a single-wire network and a more general multi-conductor transmission-line network are considered with numerical results for the voltages at points within the networks displayed.
Author (GRA)

N78-21350# Ohio State Univ., Columbus. Electroscience Lab.
ANALYSIS OF THIN-WIRE ANTENNAS IN THE PRESENCE OF A DIELECTRIC AND/OR FERRITE INHOMOGENEITY
P. Tulyathan and E. H. Newman Sep. 1976 43 p refs
(Grant DAAG29-76-G-0067)
(AD-A049455; ESL-4311-2; ARO-13331.1-EL) Avail: NTIS HC A03/MF A01 CSCL 09/5

A moment method solution for treating thin-wire antennas in the presence of an arbitrary dielectric and/or ferrite inhomogeneity is presented. The wire is modeled by an equivalent surface current density and the dielectric/ferrite inhomogeneity is modeled by equivalent volume polarization currents. The conduction currents on the wire and the polarization currents in the dielectric/ferrite inhomogeneity are treated as independent unknowns and determined in the moment method solution. The method is applied to the problem of a loop antenna loaded with dielectric or ferrite. Numerical results are presented, and are in good agreement with measurements and previous calculations. The material contained in this report is also used as a thesis submitted to the Department of Electrical Engineering, The Ohio State University as partial fulfillment for the degree Master of Science. Author (GRA)

N78-21351# Ohio State Univ., Columbus. Electroscience Lab.
THE CIRCUMFERENTIAL VARIATION OF THE AXIAL COMPONENT OF THE CURRENT IN CLOSELY SPACED THIN-WIRE ANTENNAS
P. Tulyathan and E. H. Newman Oct. 1977 26 p refs
(Grant DAAG29-76-G-0067)
(AD-A049456; ESL-4311-6; ARO-13331.2-EL) Avail: NTIS HC A03/MF A01 CSCL 09/5

Closely spaced thin-wire antennas are analyzed by the moment method using the piecewise-sinusoidal function to describe the current variation along the length of the wire and a Fourier series for the circumferential variation. Data are presented for the circumferential variation of the surface current density of parallel dipoles obtained by the 'thin-wire' theory, wire-grid model, and the present formulation. Author (GRA)

N78-21352# Hughes Research Labs., Malibu, Calif.
UNSTRUCTURED CONTROL AND COMMUNICATION PROCESSES IN REAL WORLD SCENE ANALYSIS Final Scientific Report, 1 Apr. 1974 - 15 Aug. 1977
Bruce L. Bullock Oct. 1977 76 p refs
(Contract F44620-74-C-0054)
(AD-A049458; HRL-CS-1; AFOSR-77-1303TR) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report summarizes research results from a program directed toward developing scene-analysis technology to deal with the problems of scene-analysis organization, control, and low-level feature extraction. The work on organization and control has concentrated on the use of a production system framework. To understand the limitations of production systems in buildings scene-analysis systems, both a high-level and low-level vision system were implemented. The performance of these systems is described in terms of ease of modification, ease of programming, and ability to embed appropriate domain-dependent knowledge. Several low-level feature-extraction techniques have also been developed concurrently on this program. These include an evaluation of edge operators, use of texture statistics, a glancing operator based on texture properties, and a representation for range motion. A summary is included that places these results in perspective with current work in scene analysis. Author (GRA)

N78-21353# GTE Sylvania, Inc., Needham Heights, Mass. Communications Systems Div.
TRAFFIC FLOW, PERFORMANCE AND INTERFACE CHARACTERIZATION STUDY FOR EUROPE Final Report
18 Oct. 1977 192 p refs
(Contract DCA100-76-C-0047)
(AD-A049462; AD-E100013) Avail: NTIS HC A09/MF A01 CSCL 17/2

The stated objective of this study was to collect and analyze current common use voice requirements data and relate it to the DCEC requirements project ion methodology to support DCA system planning and engineering. The achievement of this goal required three major areas of effort. The first was to develop and implement a process for characterizing U. S. Forces in Europe in such a manner that the resultant force element groupings would be uniquely identifiable and be capable of having their voice traffic measured or derived independently of other force element groups. The second was to measure voice traffic in the European DDS (and, if possible, the non- DCS common user voice systems) which could be applied to the force element stratification developed in the first effort. Third and most important was to conduct analytic efforts to define a process whereby the desired traffic needline estimation capability could be provided through appropriate mergings of the results of the first two efforts. Author

N78-21354# Stanford Univ., Calif. Electronics Labs.
A STUDY OF THE PENINSULA METHOD FOR THE CONTROLLED ARTIFICIAL GENERATION OF ULF WAVES IN THE IONOSPHERE AND MAGNETOSPHERE Technical Report, Jan. 1975 - Feb. 1977
A. C. Fraser-Smith, O. G. Villard, Jr., and D. M. Bubenik Dec. 1977 48 p refs
(Contract N00014-75-C-1095; ARPA Order 1733)
(AD-A049514; SU-SEL-77-041; SU-TR-4207-7) Avail: NTIS HC A03/MF A01 CSCL 04/1

This report presents the results of an investigation of a proposed method for the controlled artificial generation of ultra-low-frequency (ULF) hydromagnetic waves, primarily of class Pc 1 (0.2 to 5 Hz), in the ionosphere and magnetosphere. The basis of this method, which is called the 'peninsula method' (a second possible method, the 'VLF method', is discussed in a companion report), is the passage of a ULF-modulated electric current around a relatively nonconducting peninsula in the sea or in a large saline lake to form a ULF current loop that produces a ULF magnetic field in the lower ionosphere. Provided the amplitude of the ULF magnetic field fluctuations is sufficiently large, i.e., provided the maximum magnetic moment of the peninsula current loop is greater than about 10 to the 13th power Am2, it is predicted theoretically that ULF hydromagnetic waves can be generated in a disturbed region of the lower ionosphere above the peninsula. These waves can then propagate away to large distances in the ionosphere and magnetosphere. The peninsula method is a version of a particular class of ULF wave generation methods based on the use of large ground-based ULF current systems. Compared with other possible methods of generation, these methods appear to have the advantage of reliability and versatility. However, both the construction costs and the power requirements for these systems are large. GRA

N78-21355# Fairchild Republic Co., Farmingdale, N. Y.
PULSED PLASMA RADIO FREQUENCY INTERFERENCE STUDIES Final Report, 17 Jun. 1976 - 1 Sep. 1977
Martin Begun and William Guman Edwards AFB, Calif. AFRPL Sep. 1977 53 p refs
(Contract F04611-76-0057)
(AD-A049581; AFRPL-TR-77-85) Avail: NTIS HC A04/MF A01 CSCL 17/2

An unshielded external test set was developed which allows the millipound thrust level pulsed plasma thruster to be repetitively operated in air. The present design was operated at a peak discharge current of 47 kiloamperes. Electromagnetic emission tests carried out showed that the present unshielded test set would have to be shielded if the pulsed noise generated by it has to meet RE02 electric field and magnetic field requirements. The results of the noise measurements presented can be used as a basis for the design of the shielding. Shielding effectiveness measurements have shown that EMI gaskets are not required in the covers of the thruster enclosure if the covers are well fitted and secured by a double row of alternately spaced screws.
Author (GRA)

N78-21356# Radio Corp. of America, Camden, N. J.
STUDIES FOR THE DEVELOPMENT OF A UNIFIED NODE

EMPLOYING DYNAMIC CHANNEL LOCATION Final Technical Report, Mar. 1975 - Apr. 1977
Bernard Patrusky, Kenneth Bodzioch, Robert Chan, William Gesek, and Dan Heist Dec. 1977 398 p
(Contract F30602-75-C-0109)
(AD-A049619; RADC-TR-77-380) Avail: NTIS HC A17/MF A01 CSCL 17/2

RCA, during the period from March 3, 1975 until April 1977, has been engaged in studies, brassboard development, analysis and experiments whose objectives have been to prove the feasibility of the concept of a Unified Node Employing Dynamic Channel Allocation. The unified node concept is the concept of integrating circuit switch, message switch, and packet switch functions within a single node so that the node can provide appropriate switching and processing services to a wide variety of voice and data users. The dynamic aspect of this concept deals with the composition of the internodal trunks. The internodal trunks employed are wideband trunk(s) (e.g. T sub 1 rates) which contain digitized voice time slots and non-real time data that is multiplexed in a frame structure and varied dynamically. Minimal restrictions are placed on channel data rates of voice data and the trunks are transparent to binary data transfers.
GRA

N78-21357# Sachs/Freeman Associates, Inc., Hyattsville, Md.
IEMCAP IMPLEMENTATION STUDY. VOLUME 2: ANNEX ELECTROMAGNETIC COMPATIBILITY HANDBOOK FOR SYSTEM DEVELOPMENT AND PROCUREMENT Final Technical Report
E. Freeman Griffiss AFB, N. Y. RADC Dec. 1977 77 p
(Contract F30602-76-C-0356)
(AD-A049738; RADC-TR-77-376-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 20/3

This volume contains an EMC handbook to be used by both the Air Force System Project Offices and by their prime or integrating contractors to aid them in applying computerized intrasystem analysis techniques to their program. The Air Force Intrasystem Analysis Program (IAP) is discussed in detail. Both the SPO's EMC responsibilities and the contractor's EMC responsibilities are addressed. The EMC Program Plan is outlined. Also, guidance is given on the organization and operation of the EMC Advisory Board. Author (GRA)

N78-21358# McDonnell-Douglas Corp., St. Louis, Mo.
HF RADIATION CHARACTERISTICS OF THE RH-53D HELICOPTER AND THE MARK 105 AMCM SYSTEM Final Report, 1 Nov. 1976 - 1 Feb. 1977
L. N. Medgyesi-Mitschang Feb. 1977 44 p refs
(Contract N61331-76-M4839)
(AD-A049795; MDC-Q0616) Avail: NTIS HC A03/MF A01 CSCL 09/5

A computer algorithm is used to predict the power gain and phase characteristics of the Raydist receiving antenna (modified retractable hf type) used aboard the RH-53D helicopter. The calculations were performed at 1.6 and 3.3 MHz for the horizontal plane. Both vertical and horizontal polarizations were considered. Four different tow cable configurations were investigated and their effect on the receiving antenna system were determined. Author (GRA)

N78-21359# Mississippi Univ., University. Dept. of Electrical Engineering.
SMALL APERTURE ON A MULTICONDUCTOR TRANSMISSION LINE FILLED WITH INHOMOGENEOUS DIELECTRICS Final Report, 1 May 1976 - 30 Sep. 1977
Darko Kajfez and Donald R. Wilton 1 Nov. 1977 120 p refs
(Grant AF-AFOSR-3025-76; AF Proj. 2301)
(AD-A050099; AFOSR-78-0104TR; FR-2) Avail: NTIS HC A06/MF A01 CSCL 09/1

The penetration of the electromagnetic pulse through a small aperture in the conducting plane is studied, when a multiconductor transmission line is located behind the aperture. The multiconductor transmission line is filled with inhomogeneous dielectric material, so that the propagating modes have different velocities. The aperture is replaced by a pair of electric and magnetic current moments, and the equivalent multiport for the aperture junction is developed. The accuracy of the dipole moment approach is checked by the continuous spectrum approach, and the limits of validity are established. Author (GRA)

N78-21360# Mississippi State Univ., Mississippi State. Dept. of Electrical Engineering.
A STUDY OF THE WAVEGUIDE MODE EXCITATION AND PROPAGATION IN A PARALLEL PLATE TRANSMISSION LINE Final Report
Terry T. Crow, Kuang Yuh Wu, and Claborne D. Taylor Nov. 1977 64 p refs
(Grant AF-AFOSR-3065-76)
(AD-A050118; AFOSR-78-0103TR) Avail: NTIS HC A04/MF A01 CSCL 09/5

A study of the waveguide mode excitation and propagation is made for a parallel plate waveguide. Since this configuration is used in the simulation of the nuclear electromagnetic pulse, results appropriate for various simulators are obtained and discussed. The analysis assumes infinitely wide plates, but the question of finite width plates is addressed. Author (GRA)

N78-21361# Illinois Univ., Urbana-Champaign. Electromagnetics Lab.
EFFICIENT COMPUTATION OF RADIATION PATTERNS AND CONTOUR BEAM SYNTHESIS USING REFLECTOR ANTENNAS Interim Scientific Report
R. Mittra Sep. 1977 58 p refs
(Grant AF-AFOSR-3375-77)
(AD-A050132; UIEM-77-18; UILU-ENG-2261; AFOSR-78-0034TR) Avail: NTIS HC A04/MF A01 CSCL 20/14

In this report, we discuss two important aspects of reflector antennas, viz., secondary pattern computation of symmetric and offset reflectors and the problem of synthesizing contour beams using reflector antennas. A new technique is described for computing the radiation pattern from the knowledge of the surface current of the reflector, or the primary pattern of the feed. Numerical results illustrating the efficiency of the method are given. Finally, two methods for addressing the problem of synthesizing contour beams are presented. One of these is basically an analytical technique and the other is based on a numerical optimization procedure. Author (GRA)

N78-21362# Defense Communications Engineering Center, Reston, Va. Switched Networks Engineering Div.
PERFORMANCE MEASUREMENTS OF THE CVSD SPEECH CODING ALGORITHM
William Belfield Aug. 1977 25 p refs
(AD-A050163; AD-E100024; TN-6-77) Avail: NTIS HC A07/MF A01 CSCL 17/2

A set of experiments was conducted to evaluate the performance of the Continuously Variable Slope Delta (CVSD) speech coding algorithm. These experiments quantitatively measured the performance sensitivity of CVSD coding with respect to the algorithm parameters. The parameters examined included time constants, compression ratio, and filter bandwidths. The performance of a CVSD coder in terms of speech quality and intelligibility depends on the values of these parameters. Performance also depends to some extent on the type of implementation; that is, analog or digital. In addition to measuring the relative sensitivity of the algorithm to the basic parameters, these experiments were also used to determine an appropriate set of parameters for DCS applications. It was found that CVSD performance is most sensitive to compression ratio. Relatively high values of compression ratio result in the best performance. In addition, the results indicate a user preference for a filter bandwidth of 3 kHz compared with a bandwidth of 4 kHz. Based on these results, certain parameters have been selected for CVSD coder operation under conditions of moderate transmission bit error rates. Author (GRA)

N78-21363# McDonnell Aircraft Co., St. Louis, Mo.
MULTIBAND ANTENNA SYSTEM FOR TACTICAL AIRCRAFT Final Report, 30 Dec. 1976 - 15 Aug. 1977
F. W. Vortmeier Sep. 1977 527 p
(Contract N62269-77-C-0138)
(AD-A049699; NADC-76240-20) Avail: NTIS HC A23/MF A01 CSCL 17/2

The ability to extend the frequency range of a 100 MHz to

40 MHz antenna to include the 30 MHz to 100 MHz range was examined through analysis and testing. Antenna impedance, patterns, power handling and gain comparison measurements were made over the extended frequency range. The measurements were made on full scale as well as fifth and quarter scale models. Results show that it is possible to construct an antenna that will radiate from 30 MHz to 400 MHz effectively without the need for active tuning. A single input connector to the antenna is used. A mechanical design study was performed to demonstrate the feasibility of locating this antenna in the vertical stabilizer of the F-4 and F-18 aircraft. In the case of the F-4, retrofit possibilities were investigated and a flyable fincap antenna was fabricated. The results of the mechanical study showed that it is feasible to use the antenna in the F-4 and F-18 as well as other Navy aircraft including the AV-8. Author (GRA)

N78-21364# Army Communications-Electronics Engineering Installation Agency, Fort Huachuca, Ariz. Propagation Engineering Div.

ANTENNA SELECTION FOR IONOSPHERIC TELECOMMUNICATION SYSTEMS Final Memo

George Lane Jan. 1977 8 p ref

(AD-A049549; EMEO-PED-TM-77-1) Avail: NTIS HC A02/MF A01 CSCL 09/5

This memorandum presents the general principles used in the design analysis of ionospheric telecommunication systems. In particular the requirements imposed by the propagating media are discussed. A technique for data presentation of predicted circuit performance is given in addition to several nomographs which are useful to the antenna selection process. Author (GRA)

N78-21365# Arizona Univ., Tucson. Engineering Experiment Station.

EXCITATION OF A WIRE IN A RECTANGULAR CAVITY. PART 1: THEORY Final Report, 1 May 1976 - 15 Jun. 1977

D. B. Seidel 15 Jun. 1977 98 p refs

(Grant AF-AFOSR-3009-76)

(AD-A050073; AFOSR-78-0072TR-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 20/3

In this paper, the task was undertaken to formulate and numerically solve the problem of an aperture excited wire scatter in a rectangular cavity. The formulation, although tedious, was relatively straightforward. It was found that the major difficulties of the problem lay in the numerical evaluation of the infinite double sum Green's functions for the cavity interior. By considering the preliminary two-dimensional problem valuable insight was obtained toward resolving the numerical difficulties of the three-dimensional problem. It is important to realize that the two-dimensional problem is also a significant problem in and of itself. Two-dimensional problems in many cases provide adequate models for more complex three-dimensional structures. In addition, solutions to this problem have the advantage of being applicable to large apertures whereas the major solution herein is restricted to small apertures only. The real significance of this work demonstrated that the dyadic Green's functions for the cavity problem can be calculated although in some gases, only with considerable effort. This finding is particularly essential in or near the source region. GRA

N78-21366# Arizona Univ., Tucson. Engineering Experiment Station.

EXCITATION OF A WIRE IN A RECTANGULAR CAVITY. PART 2: COMPUTER DOCUMENTATION Final Report, 1 May 1976 - 15 Jun. 1977

D. B. Seidel 15 Jun. 1977 64 p refs

(Grant AF-AFOSR-3009-76)

(AD-A050074; AFOSR-78-0073TR-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 20/3

In this work, the problem of determining the currents excited on a wire enclosed within a rectangular cavity is considered. The wire and cavity interior are excited by electromagnetic sources exterior to the cavity which couple to the cavity interior through a small aperture in the cavity wall. It is assumed that the wire is thin, straight and oriented perpendicular to one of the cavity walls. An integral equation is formulated for the problem in the frequency domain using equivalent dipole moments to approximate the effects of the aperture. This integral equation is then solved numerically by the method of moments. The dyadic Green's functions for this problem are difficult to compute numerically; consequently extensive numerical analysis is necessary to render the solution tractable. Sample numerical results are presented for representative configurations of cavity, wire and aperture, and suggestions for future extensions of this work are discussed. Author (GRA)

N78-21367# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.

A GENERAL APPROACH FOR KINEMATIC WAVES Interim Report, 1 Oct. 1976 - 15 Dec. 1977

Wilson C. Chin 10 Sep. 1977 116 p refs

(Grant AF-AFOSR-2730-74)

(AD-A050077; AFOSR-78-0059TR) Avail: NTIS HC A06/MF A01 CSCL 20/11

Whitham's results for slowly varying wavetrains are generalized to include: (1) explicitly the effect of modal dependence, (2) the effect of low-order linear or nonlinear nonconservative terms and their role in modifying the basic competition between frequency and amplitude dispersion, (3) the effects of moving media, rotational or irrotational, and space-time inhomogeneities, and (4) the effect of high-order dispersive or diffusive modifications to the low-order amplitude and phase equations. A modal law is also derived which, when integrated over the cross-space, leads to a generalized Whitham action law modified by a source term that is introduced by nonconservative effects; the use of complex frequencies here is avoided, thus enabling linear and nonlinear problems to be treated on an equal basis. A self-consistent perturbation method is presented that leads to generalizations and extensions of those ideas due to Whitham, Hayes, Davey, Stewartson, Bretherton and Garrett, Taylor, Landahl, and others, and shows how each of these generalized subsets appears as a specific limit of a broader theory. A number of examples illustrating the basic ideas are presented and which lead to simple formulas that can be used in many direct applications of the general theory. GRA

N78-21368# California Univ., Livermore. Lawrence Livermore Lab.

EVALUATION OF TWO COMPUTER PROGRAMS FOR MODELING ELECTROMAGNETIC INTERACTIONS WITH SURFACES

T. H. Lehman, D. L. Lager, and A. J. Poggio 20 Sep. 1977 27 p refs

(Contract W-7405-eng-48)

(UCRL-52321) Avail: NTIS HC A03/MF A01

Two computer programs designed to determine the electromagnetic scattering characteristics of thin plates were tested and evaluated with particular attention directed to program convergence characteristics, efficiency, and adaptability to arbitrarily shaped surfaces. The program based on finite element formulation produced convergence difficulties and used excessive computer time. The program also required the addition of a somewhat fictitious thickness parameter. Reformulated expressions may circumvent some of these difficulties. The BNTPLT program, which is based on a mixed potential approach, performed more satisfactorily, but not significantly better than the existing NEC program to justify an extension of its use for general surfaces. ERA

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N78-21369 Duke Univ., Durham, N. C.

APPLICATION AND THEORETICAL STUDIES OF SILVER AND MERCURIC SULFIDE-BASED ION SELECTIVE ELECTRODES Ph.D. Thesis

Paul Kwo-chu Tseng 1977 195 p

Avail: Univ. Microfilms Order No. 77-31701

When the silver sulfide electrode was used in some simple thiols dissolved in sodium hydroxide aqueous solutions, linear plots of E (cell potential) vs ln [L] ([L] is the concentration of the thiol) were obtained in those cases where [L] is greater than alpha. Such a response is explained by the complexation reaction between the thiol ligand and the defect silver ions at the electrode surface. Though several thiols were successfully measured by the silver sulfide electrode, this potentiometric method cannot be generally applied to all the thiols. The role of HgS in the membrane is only to provide conductance while the Hg2Cl2 is the major active component for the electrode response. Accordingly, the membrane, HgS/Hg2Cl2, may be assumed to have both an ion exchange interface and an electron exchange interface. The HgS/Hg2Cl2 electrode was successfully used to determine the sulfite ion by a direct potentiometric measurement. The response to the sulfite ion is proposed to be due to a disproportionation reaction of the Hg2Cl2. Dissert. Abstr.

N78-21370 California Univ., San Diego.
APPROXIMATIONS FOR THE AMPLITUDE DISTRIBUTION AND DENSITY OF SHOT PROCESSES Ph.D. Thesis
On-Ching Yue 1977 186 p
Avail: Univ. Microfilms Order No. 78-02113

Shot processes are very useful models for noises found in a variety of engineering applications. However, the problem of detection of signal in shot noise has remained largely unsolved because of the lack of convenient expressions for the noise density and distribution, except in a few special cases. Three methods for approximating the noise density are considered and their accuracy by comparing the approximate density with the exact one in several cases of interest is demonstrated.
Dissert. Abstr.

N78-21371 Oklahoma State Univ., Stillwater.
A STUDY OF THE FIELD MODULATED GENERATOR SYSTEM Ph.D. Thesis
Chi-Cheng Tsung 1976 137 p
Avail: Univ. Microfilms Order No. 7801354

The analysis and development of a mathematical model for the field modulation generator system (FMGS) which can be used to better design, scale up and control this system was studied. Paralleled bridge rectifier system with bridge input capacitors plays a central role in the operation of FMGS. This circuit was analyzed for resistive load conditions. Angles gamma and beta related to the on and off conditions of various diodes were computed and presented for different values of nondimensional circuit constants as parameters. Harmonic content of key current and voltage waveforms were evaluated and presented in terms of families of curves. Dissert. Abstr.

N78-21372*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA CHARGING ANALYZER PROGRAM: A COMPUTER TOOL THAT CAN EVALUATE ELECTROSTATIC CONTAMINATION
N. John Stevens, James C. Roche, and Myron J. Mandell (Systems Sci. and Software, La Jolla, Calif.) 1978 14 p refs Presented at Intern. Spacecraft Contamination Conf., Colorado Springs, Colo., 7-9 Mar. 1978; sponsored in part by NASA and AF
(NASA-TM-73889; E-9526) Avail: NTIS HC A02/MF A01 CSCL 09C

A computer code, the NASA Charging Analyzer Program (NASCAP), was developed to study the surface charging of bodies subjected to geomagnetic substorm conditions. This program will treat the material properties of a surface in a self-consistent manner and calculate the electric fields in space due to the surface charge. Trajectories of charged particles in this electric field can be computed to determine if these particles enhance surface contamination. A preliminary model of the Spacecraft Charging At The High Altitudes (SCATHA) satellite was developed in the NASCAP code and subjected to a geomagnetic substorm environment to investigate the possibility of electrostatic contamination. The results indicate that differential voltages will exist between the spacecraft ground surfaces and the insulator surfaces. The electric fields from this differential charging can enhance the contamination of spacecraft surfaces. Author

N78-21373*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INVESTIGATION OF HIGH VOLTAGE SPACECRAFT SYSTEM INTERACTIONS WITH PLASMA ENVIRONMENTS
N. John Stevens, Frank D. Berkopec, Carolyn K. Purvis, Norman Grier, and John V. Staskus Apr. 1978 22 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego Calif., 25-27 Apr. 1978; sponsored by AIAA and DGLR
(NASA-TM-78831; E-9536) Avail: NTIS HC A02/MF A01 CSCL 09C

An experimental investigation was undertaken for insulator and conductor test surfaces biased up to + or - 1kV in a simulated low earth orbit charged particle environment. It was found that these interactions are controlled by the insulator surfaces surrounding the biased conductors. For positive applied voltages the electron current collection can be enhanced by the insulators. For negative applied voltages the insulator surface confines the voltage to the conductor region. Understanding these interactions and the technology to control their impact on system operation is essential to the design of solar cell arrays for ion drive propulsion applications that use direct drive power processing. Author

N78-21374*# Raytheon Co., Waltham, Mass.
SURFACE ACOUSTIC WAVE STABILIZED OSCILLATORS Final Report, Sep. 1976 - Dec. 1977
T. E. Parker Jan. 1978 61 p refs
(Contract NAS5-23701)
(NASA-CR-156724; S-2300) Avail: NTIS HC A04/MF A01 CSCL 09A

A number of 401.2 MHz surface acoustic wave (SAW) controlled oscillators were built and tested. The performance of these oscillators was evaluated for possible use as stable oscillators in communication systems. A short term frequency stability of better than 1 x 10 to the minus 9th power for one second was measured for the SAW oscillators. Long term frequency drift was measured and was found to be dependent on SAW design and packaging. Drift rates ranging from 15 ppm in twenty weeks to 2.5 ppm in twenty weeks were observed. Some further improvement was required. The temperature dependence of the saw oscillators was evaluated and it was concluded that some form of temperature compensation will be necessary to meet the requirements of some communication systems. Author

N78-21375# Naval Research Lab., Washington, D. C. Plasma Physics Div.
CALCULATION OF OPTIMUM OPERATING PARAMETERS FOR A GYROTRON TRAVELING WAVE AMPLIFIER Interim Report
K. R. Chu (Sci. Appl., Inc., McLean, Va.), A. T. Drobot (Sci. Appl., Inc., McLean, Va.), V. L. Granatstein, and J. L. Seftor Oct. 1977 28 p refs
(XF54581091; SF3230241-B)
(AD-A049506; AD-E000092; NRL-MR-3553) Avail: NTIS HC A03/MF A01 CSCL 09/1

Optimum operating parameters are determined for a new type of high power, high efficiency generator of millimeter waves known as a gyrotron travelling wave amplifier. In the example considered, wave amplification results from the interaction of a TE(01) waveguide mode with the fundamental cyclotron harmonic of an electron beam. The parameter optimization involves the determination of the point of maximum device efficiency as a function of beam density, beam energy, beam positioning, and external magnetic field for the output power required. An analytical linear theory and a numerical simulation code form the basis of theoretical calculations. As a result of the extensive survey in parameter space, the peak efficiency in the beam frame has been found to exceed 70%. This result has been applied to the specific design of a 35 GHz amplifier with output power approximately 340 kW, a power gain of 2 db/cm, and a laboratory frame efficiency of 51%. Author (GRA)

N78-21376# TRW Defense and Space Systems Group, Redondo Beach, Calif.
STORED CHARGE RELEASE IN CABLES IN LOW FLUENCE X-RAY ENVIRONMENTS Progress Report, Jan. - Apr. 1977

David M. Clement, T. J. Sheppard, L. Carlisle Nielsen, and Charles E. Wuller 8 Apr. 1977 42 p refs
(Contract DNA001-77-C-0084)
(AD-A050112; AD-E300086; DNA-4406T) Avail: NTIS HC A03/MF A01 CSCL 20/3

Stored charge release in cables exposed to low fluence X-radiation has been investigated in the SPI-6000 X-ray simulator. No anomalous response in vacuum has been observed in all cable samples except semirigid cables. However, even for semirigid cables this anomalous behavior disappears if the cable is not bent. Author (GRA)

N78-21377# Varian Associates, Palo Alto, Calif. Microwave Tube Div.
KLYSTRON-TWT HYBRID EFFICIENCY IMPROVEMENT Final Report, Jul. 1976 - Aug. 1977
Robert J. Butwell Griffiss AFB, N.Y. RADC Dec. 1977 44 p
(Contract F30602-76-C-0130)
(AD-A050125; RADC-TR-77-387) Avail: NTIS HC A03/MF A01 CSCL 09/1

This report covers a theoretical and experimental investigation of methods of improving the conversion efficiency of S-band Klystron-TWT Hybrid approximately 1 MW of peak power. The 'short stack' intense interaction cloverleaf structure was further developed as the output section of an S-band Twystron. Additional mode loading cavities were added. The coupling slot lengths were lengthened. The two high level bunching cavities in the Klystron section were modified. The gun used in prior work was modified to improve the beam-circuit interaction. Computer-aided calculations predicted 37% minimum efficiency over a 10% bandwidth with a midband efficiency of 51%. The additional mode loading rendered the tube absolutely stable. The elimination of the higher order mode in the two klystron cavities provided a significant improvement in the gain response. The increase in slot lengths seemed to reduce the magnitude of the efficiency dip. The gun modification and the increase in slot length worsened the beam-circuit interaction as judged from measured efficiencies of only 3/5 of those predicted. Performance at the design voltage and current is representative of performance in all regions tested. The swept response showed a midband efficiency of 27% with a 1.5 db bandwidth of 325 MHz.
Author (GRA)

N78-21378# Martin Marietta Aerospace, Orlando, Fla.
QUANTIFICATION OF PRINTED CIRCUIT BOARD (PCB) CONNECTOR RELIABILITY Final Technical Report, Sep. 1976 - Sep. 1977
George F. Guth Griffiss AFB, N.Y. RADC Jan. 1978 44 p refs
(Contract F30602-76-C-0439)
(AD-A049980; OR14834; RADC-TR-77-433) Avail: NTIS HC A03/MF A01 CSCL 09/1

Martin Marietta Corporation conducted a 12-month program to develop a failure rate mathematical model for printed circuit board connectors as used in military electronic equipment and conforming to the requirements of MIL-C-21097 and MIL-C-55302. This model is provided in the format of a subsection to Section 2.11 of MIL-HDBK-217B, and includes the model, instructions for its use, and limitations in its use. More than 736 million part-hours of operating field data were collected from industrial and government data sources. Data was analyzed manually and sorted by computer. Conclusions are summarized in the revised base failure rates and mathematical models described. Failure rates show a significant decrease from the present rates described in MIL-HDBK-217B. The mathematical model is described with a multiplying cyclic parameter (PI sub K) which varies in accordance with mating/unmating cycles of each connector. Author (GRA)

N78-21379# Goodyear Aerospace Corp., Akron, Ohio.
ASSOCIATIVE ARRAY PROCESSING OF RASTER SCANNED DATA FOR AUTOMATED CARTOGRAPHY II: IMPROVED RESOLUTION AND DATA HANDLING Final Technical Report, May 1976 - Oct. 1977
N. J. Adams, J. M. Vocar, and K. Losch Nov. 1977 163 p
(Contract DAAG53-76-C-0146)
(AD-A049698; GER-16523; ETL-0132) Avail: NTIS HC A08/MF A01 CSCL 09/5

The primary objective of this effort was to: expand the existing STARAN cartographic raster processing capability from 4-mil in/out processing to 4-mil input with 4-mil output, 2-mil input with 2-mil output, and 1-mil input with 1-mil output; expand the I/O capabilities to include processing of ETL run-length-coded data and DMA run-length-coded data; and perform some initial investigation of contour tagging techniques. These modifications were based on the processing of map overlays up to 19 x 22 inches (data area), and include the capability to generate those symbols previously provided at 4-mil (only) processing.
Author (GRA)

N78-21380# Naval Research Lab., Washington, D. C. Surface Chemistry Branch.
MEASUREMENT OF THE CHANGES IN DISSIPATION FACTOR AND DIELECTRIC CONSTANT AS A METHOD OF EVALUATING DEGRADATION IN CAPACITOR OILS Final Report
Robert C. Bowers and Paul J. Sniegoski Dec. 1977 14 p
(AD-A050004; AD-E000108; NRL-3681) Avail: NTIS HC A02/MF A01 CSCL 20/3

The dissipation factor and dielectric constant were investigated as a method of detecting degradation of capacitor oils used in VLF transmitter capacitors. Except for water in concentrations above saturation, small amounts of polar impurities had no measurable effect on the dissipation factor of the capacitor oil now in use (an acid refined, naphthene base, hydrocarbon oil containing some aromatics). The dissipation factor of dibutyl sebacate, a possible candidate oil for use in these capacitors, however, was sensitive to polar contaminants. Author (GRA)

N78-21381# Harvard Univ., Cambridge, Mass. Div. of Applied Sciences.
NONEQUILIBRIUM PROPERTIES OF VARIABLE-THICKNESS SUPERCONDUCTING MICRO-BRIDGES Interim Report
Miguel Octavio Jan. 1978 209 p refs
(Contract N00014-77-C-0085; N00014-75-C-0648; NR Proj. 318-003)
(AD-A049779; TR-13) Avail: NTIS HC A10/MF A01 CSCL 09/5

The experimental properties of tin and lead variable-thickness micro-bridges have been investigated. The dc I-V characteristics and the high frequency response of these Josephson devices are determined or modified by nonequilibrium effects. The gap and the subharmonic gap structure observed in the dc I-V characteristics of our microbridges are used as a local thermometer in order to demonstrate the correlation between low dissipation, reduced hysteresis, and the good high frequency performance of our variable-thickness microbridges. Measurement of low voltage foot-like features of the I-V characteristics are found to be consistent with a voltage-dependent enhancement of the supercurrent induced by the disequilibrium of the quasi-particles during the Josephson cycle. Comparison of the experimental data with the predictions of the models of Golub and of Aslamazov and Larkin show many points of agreement in the regimes where these theories are applicable. GRA

N78-21382# Naval Research Lab., Washington, D. C. Tactical Electronics Warfare Div.
CRYOGENICALLY-COOLED MICROWAVE ACOUSTIC RELAY DEVICES Interim Report
Richard D. Gurney Jan. 1978 24 p refs
(AD-A049765; AD-E000115; NRL-MR-3620) Avail: NTIS HC A02/MF A01 CSCL 09/5

RF components which provide delay of microwave signals are important elements of deception electronic warfare systems. Acoustic devices are attractive for this application because of their small size and lack of dispersion, but at high frequencies and longer delays the insertion loss is substantial. This report describes work toward the development of cryogenically-cooled sapphire delay devices operating in I/J band (8-20 GHz).
Author (GRA)

N78-21383# RCA Solid State Technology Center, Somerville, N. J.
HIGH-RELIABILITY, LOW-COST INTEGRATED CIRCUITS Quarterly Development Report No. 7, 3 Aug. - 3 Nov. 1977

3 Nov. 1977 35 p refs
(Contract N00039-76-C-0240; XF54586002)
(AD-A049763) Avail: NTIS HC A03/MF A01 CSCL 09/5

Wafer fabrication is nearly completed. COS/MOS circuits have been successfully fabricated utilizing sputter etch technology for platinum definition. Trimetallization technology with silicon nitride overcoat passivation, copper beam-tape automated assembly, and silicone molding compound has proven to be the best system for fabrication of high reliability low cost integrated circuits. Author (GRA)

N78-21384# Power Electronics Associates, Inc., Lincoln, Mass.
A 10kw LIGHTWEIGHT dc CONVERTER: TECHNOLOGY FEASIBILITY STUDY FOR LIGHTWEIGHT MEGAWATT RANGE CONVERTERS Final Report, Aug. 1975 - Dec. 1976
Francisc C. Schwarz Wright-Patterson AFB, Ohio AFAPL Nov. 1977 97 p refs
(Contract F33615-76-C-2050)
(AD-A049937; AFAPL-TR-77-45) Avail: NTIS HC A05/MF A01 CSCL 10/2

The technology for an ultra-reliable, lightweight, high power dc converter is presented and supported by test data of a small 10 kW feasibility model. Reliability and a high efficiency near 97 percent are derived from a process of natural current commuration of fast switching thyristors in series resonant circuits. Lightweight is the result of an internal frequency near 10 kHz. The feasibility of 150 kW single modules with one set of thyristors is indicated. The salient features of this converter technology are highlighted. Author (GRA)

N78-21385# Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
MONOLITHIC SURFACE WAVE TRANSVERSAL FILTER Final Technical Report, Mar. 1976 - Jul. 1977
Fred Hickernell, Don Olson, and Mike Adamo Griffiss AFB, N. Y. RADC Nov. 1977 87 p refs
(Contract F30602-76-C-0134)
(AD-A049938; RADC-TR-77-370) Avail: NTIS HC A05/MF A01 CSCL 09/5

A monolithic surface wave transversal filter was designed, fabricated, and evaluated. The semiconductor and acoustic elements were developed on (001) p-type silicon oriented for acoustic transmission along the (100) direction. Surface acoustic waves were generated by zinc oxide film layer transducers into an array of 31 metal-gate NMOS piezoresistive FET taps. The drain lines of all taps were connected to serve as the rf output. The phase and amplitude of each tap was controlled by information read into a digital static shift register and a bucket brigade device respectively. The die size for a single 31 bit filter was .810 inch by .160 inch. The conversion loss of the 9.5 finger pair zinc oxide film layer transducers was 15 db. The piezoresistive tap coupling efficiency was in the 35 to 40 db region under normal operating conditions. The overall device efficiency in developing a spread waveform from a short (100 ns) rf input pulse was 75 db which include losses due to signal expansion, channel division, matching and parasitics. The direct coupled signal level was 90 db below the input signal level and the signal to noise ratio of the spread pulse was approximately 20 db. The bucket brigade device was effective in controlling tap amplitude over a 10 db range and the digital shift register provided for random biphase coding of the taps. The yield of working transversal filter chips was greater than 40 percent from 3 inch silicon wafers. GRA

N78-21386# Naval Postgraduate School, Monterey, Calif.
DESIGN OF TWO HIGH GAIN, LOW PROFILE HELICAL ANTENNAS FOR OPERATION AT 918 MHz M.S. Thesis
John Francis Bouldry Dec. 1977 50 p refs
(AD-A049950) Avail: NTIS HC A03/MF A01 CSCL 09/5

Two helical antennas were designed, fabricated and tested to permit tanks or tracked vehicles to function with a high gain, low profile antenna field pattern for a telemetry system operating at 918 MHz. The electrical properties of the helical antennas were compared to the system's dipole antennas in an attempt to enhance the operating performance of the RMS/SCORE system. Field measurements were made under the controlled conditions of an antenna field pattern range and while the RMS II system was operational. Antenna properties of gain, beamwidth, and efficiency as well as physical size and installation locations were considered for possible inclusion of helical antennas in the telemetry system. Author (GRA)

N78-21387# Aerojet Electrosystems Co., Azusa, Calif.
THIN-FILM BUCKET BRIGADE DEVICE CHARGE-TRANSFER EFFICIENCY IMPROVEMENTS FOR DISPLAY APPLICATIONS Final Report, 15 Mar. - 14 Nov. 1977
K. O. Fugate 5 Jan. 1978 45 p
(Contract N00014-77-C-0178; NR Proj. 213-155)
(AD-A050475; AESC-5626; ONR-CR213-155-IF) Avail: NTIS HC A03/MF A01 CSCL 09/1

Aerojet's approach to improving the charge-transfer efficiency (CTE) of bucket-brigade devices (BBD) for flat panel display applications is described. The task entailed studying candidate BBD configurations, making tradeoff analyses, determining factors which affect BBD CTE efficiency and analyzing display-to-cell interface circuit considerations. Recovery from initial setback in optimizing interface circuitry between BBD and classic active matrix forced an innovative approach involving a new class of active matrix (cascode circuit) to avoid requirement for high-voltage BBDs with their attendant loss of transconductance. It is concluded that full TV format display addressing can be achieved with the 99.7% BB CTE attained. This is possible with the new matrix control architecture developed for achieving the required high yield. A program for the design, construction, assembly, and testing of flat-panel displays is recommended as a means of demonstrating the matrix control concept developed. Efforts to further improve the CTE of the BBD are also recommended. Author (GRA)

N78-21388# Air Force Weapons Lab., Kirtland AFB, N. Mex.
RADIATION CHARACTERIZATION OF SEQUENTIAL LOGIC CIRCUITS Final Report
Michael G. Knoll and Keith Bobo Jan. 1978 57 p Sponsored in part by DNA
(AD-A050476; AFWL-TR-77-167) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report describes the test techniques for radiation characterizing medium and large-scale integration (MSI/LSI) sequential logic circuits where few internal nodes are available for testing. Four sequential logic devices, two transistor-transistor-logic (TTL) technology devices and two complementary-metal-oxide-silicon (CMOS) technology devices were characterized. The devices were characterized for gamma dose-rate logic upset, total gamma dose survivability, and neutron fluence survivability. The data has been analyzed to determine the applicability of the testing techniques and procedures. Author (GRA)

N78-21389# Houston Univ., Tex. Dept. of Electrical Engineering.
LOW PROFILE, PRINTED CIRCUIT ANTENNAS Final Report, 15 Jun. 1975 - 14 Sep. 1977
Liang C. Shen Oct. 1977 48 p refs
(Grants DAHC04-75-G-0187; DAAG29-75-G-0187)
(AD-A047629; ARO-13022.1-EL) Avail: NTIS HC A03/MF A01 CSCL 09/5

Printed circuit antennas consisting of a planar radiating structure over a ground plane separated by an electrically thin layer of dielectric have found application in a wide variety of systems. A particular configuration, the circular disc radiator, was chosen for a careful theoretical and experimental investigation. A zeroth order theory for the radiation properties of the antenna was derived, and the radiation pattern, resonant frequency and input impedance were measured experimentally. Author (GRA)

N78-21390# Air Force Systems Command, Wright-Patterson AFB, Ohio.
CURRENT PULSE GENERATOR WITH AMPLITUDE OF 1,000,000 A AND STABILITY OF PLUS OR MINUS .001 AT A REPETITION RATE OF TWO Hz
B. F. Bayanov, A. V. Ilin, V. N. Pakin, A. P. Panov, and G. I. Silvestrov 9 Aug. 1977 17 p Transl. into ENGLISH from Tr. Vses. Soveshchaniya po Uskor. Zaryazhennykh Chastits (USSR), v. 1, 1970 p 283-286
(AD-A049390; FTD-ID(RS)T-1291-77) Avail: NTIS HC A02/MF A01 CSCL 14/2

It is often necessary to create powerful generators which operate on an inductive load in order to obtain strong magnetic fields, as well as to use pulsed systems in acceleration equipment. Furthermore, experimental conditions sometimes place limitations on the duration and form of the current pulse and the stability of current amplitude, and also require high operating reliability. This report examines a generator which provides a unipolar sinusoidal current pulse with a base length of 1.2 ms and an amplitude of 1,000,000 amperes. It is stable with a precision of + or - 0.001 at a repetition rate of several hertz for an inductive load of 0.1 microhenry. GRA

N78-21391# Shared Applications, Inc., Ann Arbor, Mich.
ANALYSIS OF DISTRIBUTED-EMISSION CROSSED-FIELD AMPLIFIERS Final Report
Donald M. MacGregor and Joseph E. Rowe Aug. 1977 132 p refs Prepared for Lincoln Lab., MIT
(Contract F19628-76-C-0002; ARPA Order 600)
(AD-A050185; ESD-TR-268) Avail: NTIS HC A07/MF A01 CSCL 09/5

Computer simulation has been used to aid in the development of the Raytheon QKS 1705 and QKS 1842 backward-wave distributed-emission crossed-field amplifiers. At present, Shared Applications, Inc. models a reentrant tube with a planar electrode configuration. The results give insight into the electron dynamics and show good qualitative agreement with measurements. Apparently no steady RF state exists; instead the output power and anode current fluctuate by several percent over the transit time around the tube (fifteen RF periods). To simulate a backward-wave amplifier with the planar model, it is necessary to supply an estimate of RF output power and derive the RF drive power. An alternative cylindrical model has demonstrated the ballistic starting mechanisms in the CFA. This model is capable of including the space-charge forces and the complete RF interaction in both forward- and backward-wave tubes and is recommended for further development. Author (GRA)

N78-21392# Westinghouse Electric Corp., Pittsburgh, Pa. Design and Development Center.
CONTROLLED IMPEDANCE SHORT CIRCUIT LIMITER Interim Report
D. A. Paice, J. Zubek, J. Bonk, and R. P. Putkovich Sep. 1977 201 p
(EPRI Proj. 654)
(EPRI-EL-537; RR-654) Avail: NTIS HC A10/MF A01

The technical and economic factors associated with one particular fault current technique, the controlled impedance current limiter were investigated. In this method, a series tuned inductor-capacitor circuit, placed in the line, has virtually zero impedance under normal operation; however, during a fault the series tuned configuration is rapidly altered into a high resistive impedance. Five circuit variations of this limiter were examined. Performance of the resonant circuit limiters was analyzed and evaluated by using a digital computer simulation and by tests on a scaled-down model. With this current limiter, the fault current has relatively little offset and the instantaneous peak let-through current can be held to about 10 times rated current. ERA

N78-21393# California Univ., Livermore. Lawrence Livermore Lab.
LIGHT ACTIVATED SEMICONDUCTOR SWITCHES
O. S. Zucker Oct. 1977 9 p refs Presented at Seminar on Energy Storage, Compression and Switching, Canberra, Australia, 15-21 Nov. 1977 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-80046; Conf-771132-1) Avail: NTIS HC A02/MF A01

Light activation which involved flooding the depletion region with laser light provided for instantaneous conduction by creating the electron hole pairs necessary for conduction in the original position. The potentialities, both theoretical and practical, for the utilization of these devices in high-power applications were discussed. In addition, open circuiting potentialities and some techniques to improve the performance and new materials were discussed. ERA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N78-21394 Cornell Univ., Ithaca, N. Y.
HIGHER ORDER EFFECTS, STABILITY AND TRANSITION IN VERTICAL NATURAL CONVECTION FLOWS Ph.D. Thesis
Roop Lal Mahajan 1977 162 p
Avail: Univ. Microfilms Order No. 7800104

An experimental investigation was done on the mechanisms of transition in gases. For flow adjacent to a vertical uniform heat flux surface in pressurized nitrogen, both mean and disturbance quantities for the temperature and velocity fields were measured for various values of heat flux, downstream location and pressure levels. A method was described of calibrating a Disa miniature hot-wire probe in pressurized nitrogen. Perturbation analysis of higher order boundary layer effects for natural convection flow over a semi-infinite vertical uniform flux surface was presented. An analysis was done to determine the effects of the downstream variation of flow quantities, stable stratification, and compression on the stability characteristics of boundary induced flow. Dissert. Abstr.

N78-21395 Oklahoma State Univ., Stillwater.
DEVELOPMENT OF A UNIFIED APPROACH TO THE SIMULATION OF STATIC AND DYNAMIC BEHAVIOR OF LARGE MOBILE HYDRAULIC SYSTEMS Ph.D. Thesis
Seshadri Kaluan Ram Iyengar 1977 125 p
Avail: Univ. Microfilms Order No. 78-01269

The digital simulation of large mobile hydraulic systems is considered. The objective is to develop a unified approach to the portrayal of static and dynamic behavior of such systems. The limitations of the generalized network analogy are first explored. Other software are shown to impose restrictions on the manner in which components can be interconnected. New canonical forms for describing subsystems and the large system obtained by interconnecting the subsystems so as to overcome the above drawbacks are evolved. A method for qualitative appraisal of large systems is developed and used to examine the behavior of the example system. Dissert. Abstr.

N78-21396 Oklahoma State Univ., Stillwater.
DIGITAL COMPUTER SIMULATION OF THE MECHANICAL AND THERMAL RESPONSE OF COMPLEX HYDRAULIC SYSTEMS Ph.D. Thesis
Lynn Royce Ebbesen 1976 164 p
Avail: Univ. Microfilms Order No. 7801238

Development of two thermal response models for hydraulic transmission lines, the specification of a thermal model for hydraulic components other than transmission lines or heat exchangers, the development of a one dimensional thermal component wall model, and the development of an algorithm for including thermal response in a hydraulic system simulation are considered. The algorithm allowed flow in either direction at a component port without invalidating component thermal models. Algorithms were also developed to allow the use of a sparse matrix linear equation method within a general component-oriented simulation program. A component-oriented simulation program was designed which used two major routines, a preprocessor and a simulator, to first couple components to form a system as specified by user data and then to simulate the response of the resulting system. Dissert. Abstr.

N78-21397 North Carolina State Univ., Raleigh.
LAMINAR FILM CONDENSATION OF A LIQUID METAL IN A VERTICAL CHANNEL WITH VARIATIONS IN WALL TEMPERATURE Ph.D. Thesis
Tony Wayne Sigmon 1977 138 p
Avail: Univ. Microfilms Order No. 77-29642

The problem of laminar film condensation of a turbulent liquid metal vapor on a vertical channel wall is analyzed by solving the boundary layer form of the conservation equations.

Included in the problem were results due to an applied electromagnetic field and a variable channel wall temperature. The vapor phase is assumed to enter the condenser at its saturation temperature. It is also shown that the saturation temperature of the vapor remains constant and, therefore, the energy equation for the vapor phase need not be solved. The problem is solved using liquid sodium as the condensing fluid while results are given for both water and liquid sodium as cooling fluids. The temperature drop across the condensate film is shown to be small and, thus, liquid properties are assumed constant throughout the analysis. Dissert. Abstr.

N78-21398 Virginia Univ., Charlottesville.
ENHANCEMENT OF HEAT TRANSFER BY FLOW PULSATIONS Ph.D. Thesis
Osman Erdal Karamercan 1977 116 p
Avail: Univ. Microfilms Order No. 78-00449

The effects of pulsating the water stream in a stream-heated heat exchanger were investigated. Two heat exchangers were used in this study, and both were horizontal, double-pipe exchangers with steam in the shell. The pulsations were generated by means of a reciprocating pump. The frequencies used ranged up to 300 cycles per minute, and five different displacement amplitudes were used at each flow rate investigated. Average flow rates studied corresponded to a Reynolds number range of 1,000 to 50,000. The rate of heat transfer was found to increase with pulsations, with the highest enhancement in the heat transfer coefficient observed in the transition flow regime. The results were correlated using a quasi-steady state theory, according to which the time average heat transfer coefficient in pulsatile flow can be obtained from the instantaneous coefficient calculated from steady flow relationships. Dissert. Abstr.

N78-21399 Illinois Univ. at Chicago Circle, Chicago.
HEAT TRANSFER IN CONTINUUM AND RAREFIED GASES Ph.D. Thesis
Bassam Jamil Jody 1977 214 p
Avail: Univ. Microfilms Order No. 77-32752

A hot wire column type instrument was developed for the accurate measurement of steady state heat transfer rates of an electrically heated metal wire in the temperature range 350-2600 K. Measurements are reported on heated platinum and tungsten wires in vacuum and in the presence of neon, krypton, helium and xenon gases in the continuum and/or temperature-jump regimes. The thermal conductivity of each gas, and the thermal accommodation coefficient of the gas-solid interface are determined as a function of temperature. The principle of the corresponding states is applied to the thermal conductivity data and a correlation is developed for the prediction of thermal conductivity of gases over wider temperature ranges.
Dissert. Abstr.

N78-21400 Oklahoma State Univ., Stillwater.
A SYNTHESIS TECHNIQUE FOR THE RESOLUTION OF LARGE SCALE FLUID LOGIC NETWORKS Ph.D. Thesis
Jim Basuki Surjaatmadja 1976 126 p
Avail: Univ. Microfilms Order No. 7801346

The development of a synthesis method which permits a designer to systematically resolve large stochastic type sequential fluid logic networks is discussed and development of algebra and mechanized combinational synthesis method which required for the advancement of the intended sequential synthesis approach was also included. The sequential synthesis method utilizes various essential steps, which are: (1) the selection of input-output circuits; (2) redundant input state elimination; (3) redundant state elimination; (4) the utilization of the outputs as the memory variables of the system; (5) the assigning of memories; and (6) the formulation and simplification of the network equations. The technique is presented in an algorithmic manner in order to allow computer programming of the procedure. Dissert. Abstr.

N78-21401# Michigan Univ., Ann Arbor. Gas Dynamics Lab.
APL RADIOMETER WIND TUNNEL TEST PROGRAM Final Report
William W. Willmarth and D. J. Thomas (Bendix Aerospace Systems Div.) 26 Sep. 1977 79 p refs Backup document for AIAA Synoptic, "Management of Turbulent Shear Layers in Separated Flow", scheduled for publication in Journal of Aircraft in Aug. 1978
(Contract APL/JHU-600276)
(BSR-4188) Avail: NTIS HC A05/MF A01

The wind tunnel tests were conducted in three phases. A Phase 0 test series was conducted on a full scale, two dimensional radiometer housing simulator to establish and ascertain the quantitative behavior of the boundary layer around the radiometer cavity opening. A Phase I test of a complete full scale, three dimensional model of the radiometer and aircraft housing was then conducted to evaluate several possible aerodynamic deflector and flow control configurations and determine the flow interaction with the proposed radiometer air conditioning system. A Phase 2 test series was then run on an approximate 1/7 scale model of the forward portions of the RP-3A aircraft which included a simulated radiometer nose and the forward portions of the aircraft fuselage. Author

N78-21402# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
APL RADIOMETER WIND TUNNEL TEST PROGRAM WITH SIMULATED AIRCRAFT RADOME Final Report
William W. Willmarth, J. Maszatics (Bendix Aerospace Systems Div.), and E. Granholm (Bendix Aerospace Systems Div.) 26 Sep. 1977 38 p ref Backup document for AIAA Synoptic, "Management of Turbulent Shear Layers in Separated Flow", scheduled for publication in Journal of Aircraft in Aug. 1978
(Contract APL/JHU-600276)
(BSR-4230; POR-3702) Avail: NTIS HC A03/MF A01

Severe airflows encountered within the radiometer cavity during flight tests were examined. The close proximity of the aircraft fairing seal to the radiometer windows, the effect of the radome blockage, and the effects of radiometer extension, angle of attack, seal location, fences, deflectors, baffles, and a scooping nose are among the factors studied. The airborne radiometer housing with a full scale model of the upper half of the radome, pod fairing, and aerodynamic seal was evaluated in terms of alleviating the severe cavity airflows. Results indicate that the low mean and fluctuating flow conditions were obtained in the simulator radiometer model when exposed to a uniform flow with pitch angles between + or - 10 deg and the severe high speed upflow was caused by the blockage effect of the radome. Radiometer housing configurations found to be successful in preventing the severe airflow included: (1) a two foot extension of the radiometer housing; (2) a one foot extension of the radiometer with either an asymmetric set of deflectors on the present nose; or (3) a larger scooped shaped nose. J.M.S.

N78-21403*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONSTRAINED SLOSHING OF LIQUID MERCURY IN A FLEXIBLE SPHERICAL TANK
Joseph Lestingi (Akron Univ., Ohio) and Ralph Zavesky Apr. 1978 12 p refs Presented at the 13th Intern. Elec. Propulsion Conf., San Diego, Calif., 25-27 Apr. 1978; sponsored by AIAA and DGLR
(NASA-TM-78833; E-9540) Avail: NTIS HC A02/MF A01 CSCL 20D

The mercury propellant tank system developed for use with solar electric propulsion was studied to analytically determine the resonant frequencies of the tank system and compare them with the anticipated control natural frequency of the spacecraft. The system consisted of a stainless steel spherical shell and a hemispherical elastometric diaphragm. The major analytical tool used was the NASTRAN program. Six mathematical models were developed. Resonant frequencies for six harmonics were obtained for each of the six models considered. The results show that the lowest resonant frequency for the tank system is about an order of magnitude greater than the anticipated control frequency of the spacecraft. Author

N78-21404*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BOUNDARY LAYER ANALYSIS OF A CENTAUR STANDARD SHROUD
W. R. Hingst and C. E. Towne Mar. 1978 19 p refs
(NASA-TM-78843; E-9557) Avail: NTIS HC A02/MF A01 CSCL 20D

An analytical boundary layer investigation was carried out

in conjunction with an experimental wind tunnel test to determine the discharge characteristics of the Centaur shroud ascent vent system on the Titan/Centaur launch vehicle. This involved estimating the effect of the local boundary layers on the vent discharge for vehicle Mach numbers ranging from 0.8 to 1.56. The growth of the boundary layer along the vehicle was influenced by the interaction with flanges protruding into the flow and by the longitudinal corrugations in the vehicle surface. The effects of the flange and corrugations were treated by approximate techniques. In addition, boundary layer calculations were made for a 3 percent model of the launch vehicle compared with experimental results. Author

N78-21405# Toronto Univ. (Ontario). Institute for Aerospace Studies.

EFFECTS OF IMPURITIES ON SHOCK WAVE STABILITY AND STRUCTURE IN IONIZING MONATOMIC GASES

F. C. Tang Nov. 1977 90 p refs

(Grant AF-AFOSR-3303-77)

(UTIAS-TN-212; CN-ISSN-0082-5263) Avail: NTIS HC A05/MF A01

The effects of impurities - hydrogen, water vapor, and sodium chloride - on shock wave stability and structure in ionizing-argon and krypton flows were investigated. The addition of small amounts of hydrogen to test gas stabilizes the entire flow and at the same time drastically shortens the relaxation length to about 1/3 of the original value in argon and 2/3 in krypton. The addition of about 1% of water vapor to the argon test gas also stabilizes the flow and shortens the relaxation region. A thin coating of dissolved sodium chloride in water on the shock tube wall does not seem to have any effect on the flow. The experimental results provide the data for a theoretical study which took into account atom-atom collisions, electron-atom collisions and radiation-energy losses to deduce a precise value for the atom-atom collision excitation cross-section constants for argon and krypton having values of S* sub Ar-Ar = 1.0 times 10 to the -19th power sq cm/eV and S* sub Kr-Kr = 1.2 times 10 to the -19th power sq cm/eV, respectively. Author

N78-21406*# California Univ., Los Angeles. School of Engineering and Applied Science.

CRYOGENIC-COOLANT He-4-SUPERCONDUCTOR INTERACTION Final Report

S. Caspi, J. Y. Lee, Y. I. Kim, R. J. Allen, and T. H. K. Frederking Apr. 1978 93 p refs

(Grant NsG-3153)

(NASA-CR-2963; UCLA-ENG-7767) Avail: NTIS HC A05/MF A01 CSCL 20D

The thermodynamic and thermal interaction between a type 2 composite alloy and cryo-coolant He4 was studied with emphasis on post quench phenomena of formvar coated conductors. The latter were investigated using a heater simulation technique. Overall heat transfer coefficients were evaluated for the quench onset point. Heat flux densities were determined for phenomena of thermal switching between a peak and a recovery value. The study covered near saturated liquid, pressurized He4, both above and below the lambda transition, and above and below the thermodynamic critical pressure. In addition, friction coefficients for relative motion between formvar insulated conductors were determined. Author

N78-21407*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE PERIOD OF THE COHERENT STRUCTURE IN BOUNDARY LAYERS AT LARGE REYNOLDS NUMBERS

M. A. Badri Narayanan and Joseph G. Marvin Apr. 1978 23 p refs

(NASA-TM-78477; A-7380) Avail: NTIS HC A02/MF A01 CSCL 20D

The period of the large coherent structure in a subsonic, compressible, turbulent boundary layer was determined using the autocorrelation of the velocity and pressure fluctuations for Reynolds numbers between 5,000 and 35,000. In low Reynolds number flows the overall correlation period scaled with the outer variables - namely, the free stream velocity and the boundary layer thickness. Author

N78-21408*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE TURBULENT FLOWS OF TWO-PHASE MEDIA

V. E. Nekoryakov and S. S. Kutateladze May 1978 241 p refs Transl. into ENGLISH of the book "Issledovanie Turbulentnykh Techenii Dvukh Faznykh Sred" Academy of Science, USSR, 1973 p 1-315 Transl. by Al-Ahram Center for Scientific Translations, Cairo, Egypt

(Grant NSF C-984)

(NASA-TT-F-17059) Avail: NTIS HC A11/MF A01 CSCL 20D

An electric diffusion method is used for measuring tangential pressure on canal walls, giving the possibility of fixation of local values and average flocculation of friction on the walls. The possibility of applying the electric diffusion method was shown for measuring tangential pressure in the hydrodynamics of gas liquid mixtures and the results of applying the method in some standard gas liquid flows are presented. Author

N78-21409*# National Aeronautics and Space Administration, Washington, D. C.

PROBLEMS OF HYDRODYNAMICS AND HEAT EXCHANGE

S. S. Kutateladze, ed. May 1978 279 p refs Transl. into ENGLISH of the collection "Voprosy Gidrodinamiki i Teploobmena" Novosibirsk, USSR, Inst. of Thermal Phys., Acad. of Sci. USSR, 1972 p 1-302 Sponsored by NASA Transl. by Franklin Book Programs, Cairo

(Contract NSF C-724)

(NASA-TT-F-17060; TT-76-58159) Avail: NTIS HC A13/MF A01 CSCL 20D

The distribution of local friction and the transition to turbulence at the initial section of a plane channel was studied. Aspects of the motion of a strongly compressed gas cavity between parallel and nonparallel walls were examined, and an investigation of two phase flow in a vertical tube was carried out. Turbulent heat exchange in an arbitrary change of thermal flow on a wall was reviewed as well as heat exchange of a thin cylinder with pulsating flow in a circular channel. Local friction on two phase horizontal flow was also measured. B.B.

N78-21410*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

CORRELATION OF LASER VELOCIMETER MEASUREMENTS OVER A WING WITH RESULTS OF TWO PREDICTION TECHNIQUES

Danny R. Hoad, James F. Meyers, Warren H. Young, Jr., and Timothy P. Hepner Apr. 1978 66 p refs

(DA Proj. 1L1-61102-AH-45)

(NASA-TP-1168; L-11980) Avail: NTIS HC A04/MF A01 CSCL 20D

The flow field at the center line of an unswept wing with an aspect ratio of eight was determined using a two dimensional viscous flow prediction technique for the flow field calculation, and a three dimensional potential flow panel method to evaluate the degree of two dimensionality achieved at the wing center line. The analysis was made to provide an acceptable reference for comparison with velocity measurements obtained from a fringe type laser velocimeter optics systems operating in the backscatter mode in the Langley V/STOL tunnel. Good agreement between laser velocimeter measurements and theoretical results indicate that both methods provide a true representation of the velocity field about the wing at angles of attack of 0.6 and 4.75 deg. Author

N78-21411*# National Aeronautics and Space Administration, Washington, D. C.

FLOW OF VISCOUS GAS IN THE REGION OF A SLOT WITH STRONG SUCTION

L. P. Kozlov Apr. 1978 8 p refs Transl. into ENGLISH from Dopov. Akad. Nauk Ukr. RSR, Ser. A (USSR), no. 6, 1973 p 538-541 Original language document was announced as A73-42283 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Inst. of Hydromech., Akad. of Sci. UkrRSR

(Contract NASw-2790)

(NASA-TM-75241) Avail: NTIS HC A02/MF A01 CSCL 20D

The flow of a perfect viscous gas was studied in the region of a slot with strong suction. Velocity and temperature distribution fields are computed of the case of thermally insulated and heat conducting surfaces. The dependence of the flow characteristics on the suction gas discharge is obtained for a single slot with strong suction. Author

N78-21412*# National Aeronautics and Space Administration, Washington, D. C.
EXPERIMENTAL STUDY OF THE LAMINAR-TURBULENT TRANSITION OF A CONCAVE WALL IN A PARALLEL FLOW
H. Bippes Mar. 1978 73 p refs Transl. into ENGLISH from Sitzber. Heidelberg. Akad. Wiss., Math.-Naturw. Kl., Abhandl. (Heidelberg), no. 3, 1972 p 103-180 Original language document was announced as A73-22450 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Ger. Aeronautics and Aerospace Center for Res. and Testing, Freiburg
(Contract NASw-2790)
(NASA-TM-75243) Avail: NTIS HC A04/MF A01 CSCL 20D

The instability of the laminar boundary layer flow along a concave wall was studied. Observations of these three-dimensional boundary layer phenomena were made using the hydrogen-bubble visualization technique. With the application of stereo-photogrammetric methods in the air-water system it was possible to investigate the flow processes qualitatively and quantitatively. In the case of a concave wall of sufficient curvature, a primary instability occurs first in the form of Goertler vortices with wave lengths depending upon the boundary layer thickness and the wall curvature. At the onset the amplification rate is in agreement with the linear theory. Later, during the non-linear amplification stage, periodic spanwise vorticity concentrations develop in the low velocity region between the longitudinal vortices. Then a meandering motion of the longitudinal vortex streets subsequently ensues, leading to turbulence. Author

N78-21413*# National Aeronautics and Space Administration, Washington, D. C.
THE EXECUTION OF SYSTEMATIC MEASUREMENTS ON PLANE CASCADES
Norbert Scholz Apr. 1978 56 p refs Transl. into ENGLISH from Z. Flugwiss. (West Ger.), v. 4, no. 10, Oct. 1956 p 313-333 Sponsored by NASA Transl. by Sci. Transl. Serv., Santa Barbara, Calif. Original doc. prep. by Technische Hochschule, Brunswick
(NASA-TM-75278) Avail: NTIS HC A04/MF A01 CSCL 20D

The present state of development of the experimental technique regarding the flow through cascades and several points to be specially observed in the design of cascade wind tunnels were discussed. The equations required for the evaluation of the momentum measurements in two dimensional flow through cascades were developed. Regarding the effect of the jet contraction due to the boundary layer along the side walls a simple method for correction was also given in order to obtain two dimensional flow characteristics. Also given were the equations for the evaluation of the pressure distribution measurements. Another contribution was made regarding the presentation of the test results in the form of nondimensional quantities. The results of systematic measurements of cascades with symmetrical aerofoil were reported, and the above suggested method was applied for the evaluation of the measurements. Author

N78-21414# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mathematical Science.
NUMERICAL INVESTIGATION OF THE EFFECT OF A CORIOLIS FORCE ON THE STABILITY OF PLANE POISEUILLE FLOW Interim Report
J. E. Flaherty and R. C. DiPrima Oct. 1977 42 p refs
(Grant AF-AFOSR-2818-75)
(AD-A049521; AFOSR-78-0026TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

The stability of the viscous flow between two parallel horizontal plates due to a constant reduced pressure gradient in a system rotating about a vertical axis is studied. The critical value of the Reynolds number R, based on the reduced pressure gradient, is a function of a dimensionless rotation parameter T, the Taylor number. GRA

N78-21415# Aeronutronic Ford Corp., Newport Beach, Calif.
LAMINAR BOUNDARY LAYER STABILITY MEASUREMENTS AT MACH 7 INCLUDING WALL TEMPERATURE EFFECTS Interim Report, 1 Jul. 1976 - 30 Jun. 1977
Anthony Demetriades Nov. 1977 73 p refs
(Contract F44620-75-C-0016)
(AD-A049535; V-6381; AFOSR-77-1311TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

An experiment was performed to verify and extend earlier observations of instabilities in the hypersonic laminar boundary layer of cones. The present tests were performed at edge Mach number 7 in a continuous wind tunnel, at edge Reynolds numbers from one to three million and wall-to-stagnation temperature ratios of 0.41 to 0.8. Stability data were obtained for non-dimensional frequencies as high as 5 x 10 to the -4 with high data density provided by computerized data reduction techniques, which were also used to re-examine earlier data. The results are consistent with all earlier data and reveal a complex stability diagram with at least three unstable regions. The lower of these regions appears to be generated by the first and second mode instabilities but no theoretical guidance exists to help identify the contributing modes for the other regions. The second-mode instability has the highest amplification rates and generates the optically detectable 'laminar waves'; a 'second harmonic' to these waves is generated by the modes populating the next most prominent unstable region. The stability diagram extends smoothly into the non-linear and transitional regimes, which are marked by the attainment of a maximum amplitude and then a decay, of the laminar waves. Wall cooling causes a substantial increase of the amplification rates with a concurrent upstream movement of the transition zone. Author (GRA)

N78-21416# Naval Postgraduate School, Monterey, Calif.
TRANSVERSE OSCILLATIONS OF A CIRCULAR CYLINDER IN UNIFORM FLOW, PART 1 Interim Report, 1 Sep. 1976 - 30 Aug. 1977
Turgut Sarpkaya 25 Dec. 1977 97 p refs
(AD-A049825; NPS-69SL77071-R) Avail: NTIS HC A05/MF A01 CSCL 20/11

This report presents the results of an experimental and analytical investigation of the forced oscillations of a circular cylinder in uniform flow. The transverse force has been decomposed into two components and the appropriate force coefficients have been determined experimentally through the use of a Fourier-averaging technique. The results were then incorporated into the equation of motion to predict the dynamic response of elastically-mounted cylinders. The numerical predictions were found to be in good agreement with those obtained experimentally. The results obtained with the discrete-vortex representation of the separated flow field about an oscillating cylinder will be described in a separate report. GRA

N78-21417# Naval Postgraduate School, Monterey, Calif.
EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF FLUID LOADING ON FLEXURAL WAVES IN PLATES M.S. Thesis
James Laing Jarvis Dec. 1977 70 p refs
(AD-A050020) Avail: NTIS HC A04/MF A01 CSCL 09/1

An experimental investigation was conducted of the effects of fluid loading on axially symmetric flexural waves in a circular aluminum plate 25 in. in diameter and 5/16 in. thick. Measurements were made of the flexural wavelength and natural frequencies with the plate in air, and with water loading on one side, over a frequency range from 20 kHz to 80 kHz. The critical (coincidence) frequency, that frequency at which the speed of the flexural wave equals the speed of sound in water, occurs at approximately 45 kHz. The measured flexural-wave speeds with air loading are in good agreement with theory. With water loading, the wave speed decreases, the amount of decrease increasing to approximately 14 percent below the in-air value just below the critical frequency. At the critical frequency, the wave speed appears to jump to values nearly equal to the unloaded values. Radiation patterns were obtained and when edge effects are eliminated, are in qualitative agreement with theoretical predictions for an infinite fluid-loaded plate. Author (GRA)

N78-21418# JAYCOR, Del Mar, Calif.
NUMERICAL CALCULATION OF THE STABILITY OF

PARALLEL FLOWS Final Report, 1 Jan. - 31 Oct. 1977
James H. Stuhmiller 5 Dec. 1977 39 p refs
(Contract F49620-77-C-0030)
(AD-A049983; AFOSR-78-0062TR) Avail: NTIS HC A03/MF A01 CSCL 20/4

A numerical approach to solving the two-dimensional, incompressible Navier-Stokes equations is presented and is used to study the stability and evolution of disturbance in a boundary layer. Previous numerical approaches have used streamfunction-vorticity formulations that take advantage of the special properties of two-dimensional flow. The present method solves a finite-difference form of the momentum equations and may therefore be extended to three-dimensions more readily. Computations using this technique are compared with the result of linear stability theory for small amplitude disturbances and are found to give satisfactory agreement, while calculations at large amplitude support the conjecture that non-linear effects can be destabilizing. Author (GRA)

N78-21419# Pennsylvania State Univ., State College. Applied Research Lab.
SCALING OF CAVITATION DAMAGE
David R. Stinebring 17 Feb. 1977 181 p refs
(Contract N00017-73-C-1418)
(AD-A049766; TM-76-51) Avail: NTIS HC A09/MF A01 CSCL 20/4

This investigation has focused on the initial stages of cavitation erosion using a ductile material in a flowing system employing water as the working fluid. The test models were 0.635 cm diameter zero-caliber ogives made of pure annealed aluminum. The aluminum was selected as a material which would be suitable for recording the intensity of cavitation bubble collapse. The damage in the initial stages was in the form of small indentations in the model surface. The greatest damage was within an area corresponding to the cavity closure point on the model. The pits were round depressions usually under 0.1 mm in diameter, with the majority less than 0.05 mm across. During the formation of these pits, it appears that no material was removed from the surface. Using the pure annealed aluminum test probe, a sufficient damage sample could be generated in a relatively short period of time. GRA

N78-21420# Princeton Univ., N. J. Gas Dynamics Lab.
A THREE-DIMENSIONAL STUDY OF FIN-INDUCED SHOCK WAVE TURBULENT BOUNDARY LAYER INTERACTION Interim Technical Report
D. S. Dolling, C. D. Cosad, S. M. Bogdonoff, and I. E. Vas 15 Jul. 1977 52 p refs
(Grant DAAG29-76-G-0269)
(AD-A049772; ARO-14026.1-EX) Avail: NTIS HC A04/MF A01 CSCL 20/4

Surface pressure distributions and oil streak patterns have been measured in the three-dimensional flowfield caused by the interaction of a skewed shock wave with a two-dimensional turbulent boundary layer. The boundary layer was developing on a 45 deg sweptback, sharp leading edged plate. Tests were made at a freestream Mach number of 2.95, a freestream unit Reynolds number of 63,000,000/m (1,600,000/in), a stagnation temperature of about 265 K and at near adiabatic wall temperature. Measurements have been made for generator angles in the range 0 to 12 deg in 2 deg increments. These measurements represent the first phase of a study which will include heat transfer measurements and details of the flowfield. The measured data are presented and compared with data obtained under the same shock wave conditions but with a different boundary layer. Author (GRA)

N78-21421# National Oceanic and Atmospheric Administration, Boulder, Colo.
SHEAR DISPERSION IN TIME-VARYING FLOWS
W. C. Thacker (NOAA, Miami, Fla.) May 1977 10 p
(PB-277103/8; NOAA-TR-ERL-386; AOML-27; NOAA-78011601) Avail: NTIS HC A02/MF A01 CSCL 20D

Shear dispersion in time varying flows was shown to be parameterizable as effective diffusion with a time varying diffusivity. This parameterization was appropriate only for time along in comparison with the cross shear mixing time. High frequency variations of the flow did not contribute substantially to the mixing. Low frequency variations of the flow were accounted for by simply allowing the parameters in the expression for the effective diffusivity to take on a time dependence. GRA

N78-21422# Oak Ridge National Lab., Tenn. Engineering Technology Div.
ORINC: A ONE-DIMENSIONAL IMPLICIT APPROACH TO THE INVERSE HEAT CONDUCTION PROBLEM
L. J. Ott and R. A. Hedrick 18 Oct. 1977 289 p refs
(Contract W-7405-eng-26)
(ORNL-NUREG-23) Avail: NTIS HC A13/MF A01

An implicit solution technique to determine both the transient surface temperature and the transient surface heat flux of electrically heated rods given the power input and an indicated internal temperature during a simulated loss of coolant accident were reported. A digital computer program ORINC was developed which solves a one dimensional, transient, lumped parameter, implicit formulation of the conduction equation at each bundle thermocouple position. ERA

N78-21423# Solar Turbines International, San Diego, Calif.
DEVELOPMENT OF A CERAMIC TUBE HEAT EXCHANGER WITH RELAXING JOINT Quarterly Technical Progress Report, Apr. - 1 Jul 1977
Michael E. Ward and James C. Napier 19 Jul. 1977 46 p refs
(Contract EF-77-C-01-2556)
(FE-2556-06) Avail: NTIS HC A03/MF A01

The environmental rig was fabricated and installed in the test facility and desired air velocities and air temperature were achieved. High rig wall temperatures were experienced. However, cooling was increased to reduce rig wall temperatures. Six glass candidates were tentatively selected to meet engineering requirements established for the low and moderate relaxation joint temperature ranges. Preliminary results indicate that the first three glasses chosen have the desired characteristics. Preliminary design analysis has shown the preheat of a relaxation joint to be a viable and practical method for relieving cold start thermal transient stress build-up in the heater-tube system. Although the relaxing joint heat exchanger is considered the primary design, other possible heat exchanger tube and shell systems are being evaluated as alternatives. ERA

N78-21424# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Chemistry.
HEAT TRANSFER RESEARCH AND POWER CYCLE TRANSIENT MODELING
Robert R. Rothful and Charles P. Neumann 23 Mar. 1977 102 p refs Presented at 4th Ocean Thermal Energy Conversion Conf., New Orleans, 23 Mar. 1977
(Contract EY-76-S-02-2641)
(COO-2641-4; Conf-770331-3) Avail: NTIS HC A06/MF A01

Single-tube experiments with water indicated that at moderate velocities the tube-side coefficients were enhanced by a factor equal to the ratio of fluted-to-smooth surface areas while the fluid friction was similarly increased. The experimental data were transformed into mean individual coefficients for ammonia and water. Overall coefficients for a particular case were presented to illustrate the efficacy of enhancement by flutes on one or both sides of the heat transfer surface. Means were described for using emerging data to predict the static and dynamic behavior of the power cycle and the interactions of components throughout the complete power plant. ERA

N78-21425# Department of Energy, Washington, D. C.
NATURAL CIRCULATION CALCULATION: SINGLE-PHASE AND TWO-PHASE FLOW IN PIPES
G. Gyenes, V. Csom, P. Windberg, and A. Toeroek 1977 18 p refs
(DOE-tr-15) Avail: NTIS HC A02/MF A01

In planning the natural circulation of water-cooled reactors one of the most important problems is the accurate determination of the circulation velocity. This problem becomes still more complicated if boiling occurs in some sections of the reactor circuit because the calculation of the two-phase pressure drop is less accurate than that of the single-phase pressure drop, and under certain operating conditions, flow fluctuations may also occur. A bundle consisting of 19 rods was investigated in

a natural circulation loop. The natural circulation calculations performed during the preparation of this experiment are presented. ERA

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N78-21426*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A METHOD OF CALIBRATING WIND VELOCITY SENSORS WITH A MODIFIED GAS FLOW CALIBRATOR

Hampton P. Stump Apr. 1978 20 p refs

(NASA-TM-78707) Avail: NTIS HC A02/MF A01 CSCL 14B

A procedure was described for calibrating air velocity sensors in the exhaust flow of a gas flow calibrator. The average velocity in the test section located at the calibrator exhaust was verified from the mass flow rate accurately measured by the calibrator's precision sonic nozzles. Air at elevated pressures flowed through a series of screens, diameter changes, and flow straighteners, resulting in a smooth flow through the open test section. The modified system generated air velocities of 2 to 90 meters per second with an uncertainty of about two percent for speeds below 15 meters per second and four percent for the higher speeds. Wind tunnel data correlated well with that taken in the flow calibrator. Author

N78-21427*# Hyperfine, Inc., Fairport, N.Y.

RESEARCH DIRECTED TOWARD IMPROVED ECHELLES FOR THE ULTRAVIOLET Final Report, 11 Nov. 1975 - 10 Nov. 1976

2 Sep. 1977 39 p refs

(Contract NAS5-22859)

(NASA-CR-156732) Avail: NTIS HC A03/MF A01 CSCL 14B

Low frequency gratings obtainable with present technology, can meet the grating-efficiency design goals for potential space telescope spectrographs. Gratings made with changes in the three specific parameters: the ruling tool profile, the coating material, and the lubricants used during the ruling process were compared. A series of coatings and test gratings were fabricated and were examined for surface smoothness with a Nomarski differential interference microscope and an electron microsocope. Photomicrographs were obtained to show the difference in smoothness of the various coatings and rulings. Efficiency measurements were made for those test rulings that showed good groove characteristics: smoothness, proper ruling depth, and absence of defects (e.g., streaks, feathered edges and rough sides). Higher grating efficiency should be correlated with the degree of smoothness of both the coating and the grating groove. Author

N78-21428*# Dayton Univ. Research Inst., Ohio.

TEST AND DEVELOPMENT OF INFLATABLE SPHERES INSTRUMENTED WITH MINIATURIZED THERMISTORS, ACCELEROMETERS AND PRESSURE TRANSDUCERS Final Report

James K. Luers Apr. 1978 54 p refs

(Contract NAS6-2456)

(NASA-CR-2968) Avail: NTIS HC A04/MF A01 CSCL 14B

Instrumentation was developed for the high altitude inflatable sphere to measure its skin temperature, acceleration and internal pressure. The sphere without instrumentation has routinely been used over the past 10 years to provide measurements of winds, density, temperature and pressure between 100 Km and 30 Km altitude. With the miniaturized instrumentation package onboard, the system offers the potential for providing meteorological information as well as a better understanding of sphere performance and dynamics during its descent. Of the six launches of instrumented spheres only one provided telemetry data. However, many of the objectives of the program were achieved. Author

N78-21429*# Dayton Univ. Research Inst., Ohio.

AN EVALUATION OF ELECTROCHEMICAL CONCENTRATION CELL (ECC) SONDE MEASUREMENTS OF ATMOSPHERIC OZONE

Michael J. Geraci and James K. Luers Washington NASA Apr. 1978 42 p refs

(Contract NAS6-2456)

(NASA-CR-2973) Avail: NTIS HC A03/MF A01 CSCL 14B

Using Dobson spectrophotometer measurements of total ozone as a comparison, an analysis of the electrochemical concentration cell (ECC) ozonesonde's measurement accuracy is presented. Days of conjunctive ECC-Dobson observations (from 1970 to 1976 at Wallops Flight Center) provide a set of 123 pairs of total ozone values. Sample set statistics are generated with means and standard deviations of total ozone values and differences being noted. An in-depth study of factors such as time assumptions used in calculating residual ozone, and other possible sources of errors are examined. A study of ECC ozone profiles is also presented with an evaluation of sonde measurement of seasonal trends, altitude or peak ozone concentration, and other important ozone parameters. Short-period changes in total ozone using Dobson data during the observational period are also described. Author

N78-21430*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A SMALL GAS INLET SYSTEM FOR ORBITAL MASS-SPECTROMETER CALIBRATIONS

Alphonsa Smith and Richard E. Stell Apr. 1978 33 p refs

(NASA-TP-1170; L-11988) Avail: NTIS HC A03/MF A01 CSCL 14B

A gas inlet system is described for generating precise gas pressures that are to be used as calibration references for the mass spectrometers aboard the dual air density Explorer satellites. This gas inlet system was developed as an inflight calibration technique in which a known amount of onboard gas is released in the satellite cavity and is detected by the mass spectrometer. Although several flight mass spectrometer experiments have been proposed, none make use of the inflight calibration technique described in this report. Laboratory measurements and calibration of the metering leak technique for the gas inlet systems are discussed. The systems tested have metering leak rates between 2 and 4 microliters/sec at 298 K for argon-40, and they produce molecular flow up to 100 torr, which is the highest test pressure in this experiment. Test data show that metering leak rates are reproducible within 1 percent of established means for helium-3, helium-4, and argon-40. Author

N78-21431*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A FEASIBILITY STUDY OF ION IMPLANTATION TECHNIQUES FOR MASS SPECTROMETER CALIBRATION

M. E. Koslin (Rensselaer Polytech. Inst.), G. A. Krycuk (Rensselaer Polytech. Inst.), J. G. Schatz, Jr. (Rensselaer Polytech. Inst.), F. A. White (Rensselaer Polytech. Inst.), and G. M. Wood Apr. 1978 21 p refs

(NASA-TP-1185; L-11920) Avail: NTIS HC A02/MF A01 CSCL 14B

An experimental study was undertaken to examine the feasibility of using ion-implanted filaments doped with either an alkali metal or noble gas for in situ recalibration of onboard mass spectrometers during extended space missions. Implants of rubidium and krypton in rhenium ribbon filaments were subsequently tested in a bakeable 60 deg sector mass spectrometer operating in the static mode. Surface ionization and electron impact ion sources were both used, each yielding satisfactory results. The metallic implant with subsequent ionization provided a means of mass scale calibration and determination of system operating parameters, whereas the noble gas thermally desorbed into the system was more suited for partial pressure and sensitivity determinations. Author

N78-21432# Illinois Inst. of Tech., Chicago. Dept. of Mechanics, Mechanical and Aerospace Engineering.

ANALYSIS OF TEMPERATURE COMPENSATING CIRCUITS

FOR HOT-WIRES AND HOT-FILMS Interim Technical Report, 1 Jan. 1976 - 1 Jun. 1977
R. E. Drubka Jun. 1977 40 p refs
(Contract F44620-76-C-0062; Grant DAHC04-74-G-0160)
(AD-A050080; ITT-FLUIDS/HEATTRANS-R77-2;
ARO-ITR-77-2; ARO-12290.8-E) Avail: NTIS
HC A03/MF A01 CSCL 20/4

A scheme utilizing a temperature probe immersed in the working fluid to compensate for the dependence of hot-wire (or hot-film) velocity calibration on ambient temperature variations is analyzed. To achieve compensation, only properties of the anemometer bridge, the velocity and temperature probes need to be known. The scheme provides means for incorporating the temperature compensation a priori to conducting the experiments, without the need for temperature calibration. Experiments were conducted, using tungsten hot-wires in air, to check the performance of the analysis and to verify some of the assumptions that were made. For typical probes, with an ambient temperature increase of 20 C, maximum error in the indicated velocity of 1% or less can be achieved. Author (GRA)

N78-21433# Naval Research Lab., Washington, D. C.
LONG-RANGE HOLOGRAPHY FIELD EXPERIMENTS Final Report
J. A. Blodgett, R. L. Easton, Jr., and R. E. Koncen 31 Oct. 1977 25 p refs
(AD-A050122; AD-E000103; NRL-8167) Avail: NTIS
HC A02/MF A01 CSCL 14/5

An active holographic and conventional imaging techniques were compared, with the images for both cases taken simultaneously at a range of 1 km. A 1-joule Q-switched ruby laser with a 1-m coherence length was used as the light source. To obtain both a conventional image and a holographic interference pattern simultaneously through one aperture, a beamsplitter and two cameras were mounted at the focus of a 36-cm-diameter telescope. Tests were conducted for several weeks, involving 257 exposures. At best, holographic imaging showed an improvement in resolution over conventional imaging by a factor of 2 but with a decrease in signal-to-noise ratio. Author (GRA)

N78-21434# Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. Quality Div.
SMALL INNER SPHERICAL RADIUS SWEEP GAGE Final Report, Oct. - Dec. 1976
L. W. Black 1977 5 p
(Contract EY-76-C-04-0487)
(MHSMP-77-5G) Avail: NTIS HC A02/MF A01

A gage designed for sweeping a small inner spherical radius using a common full bridge strain gage as a sensing transducer is described. ERA

N78-21435# Bendix Corp., Kansas City, Mo.
LABORATORY AUTOMATIC DATA ACQUISITION SYSTEM Final Report
L. E. Schantz Sep. 1977 85 p
(Contract EY-76-C-04 0613)
(BDX-613-1566; EP-04122656) Avail: NTIS
HC A05/MF A01

The system consists of three basic blocks: the software control calculator, which controls the entire system, receives data from the system, and acts upon it in some intelligent manner; a variety of laboratory measuring equipment which gathers data and inputs it in BCD format; and the coupler/controller and patch panel combination which makes it possible for BCD information from the gathering apparatus to be transmitted to the calculator. Approximately 50 software programs were written for the system, including one which permits the automatic data acquisition system to scan resistors, measure their values, record the values, and permit the percent change in resistor values to be plotted. A program was written for data on temperature coefficients of resistance on thin film resistors. ERA

N78-21436# Kerr (Robert S.) Environmental Research Lab., Ada, Okla.
THERMOCOUPLE READOUT INSTRUMENT
Carl G. Enfield and Curtis V. Gillaspy Nov. 1977 23 p refs
(PB-275429/9; EPA-600/2-77-220) Avail: NTIS
HC A02/MF A01 CSCL 14B

An electronic circuit was developed which acts as an electronic ice bath for chromel-constant thermocouples. The electronic ice bath was accurate to within plus or minus 0.2 C from 25 C to 50 C. The thermocouple output was scaled and linearized such that the temperature can be read directly in C with a sensitivity of 100 mV/C with OVDC at 0 C. Circuit diagrams and construction considerations were included to allow the reader to construct a functioning unit. GRA

36 LASERS AND MASERS

Includes parametric amplifiers.

N78-21437 Stanford Univ., Calif.
FREE ELECTRON LASER THEORY Ph.D. Thesis
William Boniface Colson 1977 144 p
Avail: Univ. Microfilms Order No. 7802145

The behavior of the free electron laser was theoretically analyzed starting from and interrelating different points of view: classical equations of motion, quantum mechanical radiation theory, and full quantum field theory. Radiation from free relativistic electrons traveling through a static transverse periodic magnetic field feeds back on the radiating electrons and simulates the emission process. The one-body classical Lorentz force equation was solved for a relativistic electron in the presence of a periodic magnetic field and a plane electromagnetic wave. Phase space paths for electrons were related to those of a simple pendulum and describe laser gain, saturation and coherent electron beam modulation. Then, the processes of quantum mechanical stimulated emission, and absorption from an imposed radiation field of fixed frequency were considered. Dissert. Abstr.

N78-21438 Texas Christian Univ., Fort Worth.
EXPERIMENTAL DETERMINATION OF NONLINEAR CONSTANTS FOR SELF-FOCUSING AND STIMULATED RAMAN EMISSION Ph.D. Thesis
Montecue Judson Lowry 1977 161 p
Avail: Univ. Microfilms Order No. 78-01070

The nonlinearities characteristic of a liquid medium subjected to a high intensity laser beam were investigated experimentally with the main thrust of the investigation being a study of the self focusing effect and stimulated Raman scattering in eleven organic liquids. The specific objective was to measure the threshold power density for the onset of self focusing and stimulated Raman emission for four self focusing lengths, the Stokes power output for each self focusing length, and the Stokes lines emitted by each liquid under study. Dissert. Abstr.

N78-21439 Pittsburgh Univ., Pa.
COOPERATIVE SPONTANEOUS EMISSION AND NONLINEAR STIMULATED EMISSION Ph.D. Thesis
Hai-Woong Lee 1977 103 p
Avail: Univ. Microfilms Order No. 7801869

A system of atoms (an atom) interacting with a radiation field was studied using the Weisskopf-Wigner approximation. If a system consists of many excited atoms, cooperative spontaneous emission is important. Emission of radiation by a many atom system initially prepared by a plane wave pulse was studied. The results are good for any arbitrary degree of initial excitation of the system including complete inversion. A new method is presented which describes the time development of a superradiant system in a very simple way. If a system consists of an excited atom in the presence of incident radiation, stimulated emission is important. It is shown that, if the intensity of incident radiation is sufficiently high, nonlinear effects are important and the action of stimulated emission becomes so strong that spontaneous emission is negligible. Here a single mode coupling preassumed in most treatments of lasers can be justified. Dissert. Abstr.

N78-21440 Stanford Univ., Calif.
OPTICALLY PUMPED MERCURY LASER FOR ABSOLUTE FREQUENCY STABILIZATION Ph.D. Thesis
Troy Max Artusy 1977 103 p
Avail: Univ. Microfilms Order No. 7802129

The optically pumped 546.1 nm mercury laser is a low-power visible laser that is particularly attractive for frequency.

Lack of a discharge within the laser makes the Hg-N2 gain medium an essentially ideal unperturbed gas, with no active mass transport or gas clean-up mechanisms within the lasing medium. Laser excitation is accomplished by pumping the laser cell with light from a separate high intensity mercury lamp. In order to demonstrate the potential of the mercury laser for absolute frequency stabilization, several different aspects of the laser were studied. In particular, the first sealed-off 546.1nm laser was developed, and its potential for long trouble free operating life was demonstrated. Several intense non reversed mercury light sources were also constructed to excite the laser. In particular, a novel single isotope low-pressure mercury arc lamp which circumvents the problem of cataphoresis was developed.
Dissert. Abstr.

N78-21441*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REVIEW OF THE THERMOELECTRONIC LASER ENERGY CONVERTER (TELEC) PROGRAM AT LEWIS RESEARCH CENTER
D. L. Alger, E. J. Manista, and R. W. Thompson 1978 19 p refs Presented at 3d Conf. on Radiation Energy Conversion, Moffett Field, Calif., 26-27 Jan. 1978; sponsored by NASA
(NASA-TM-73888; E-9503) Avail: NTIS HC A02/MF A01 CSCL 20E

The investigation of the Thermoelectronic Laser Energy Converter (TELEC) concept began with a feasibility study of a 1 megawatt sized TELEC system. The TELEC was to use either cesium vapor or hydrogen as the plasma medium. The cesium vapor TELEC appears to be the more practical device studied with an overall calculated conversion efficiency of greater than 48%. Following this study, a small TELEC cell was fabricated which demonstrated the conversion of a small amount of laser power to electrical power. The cell developed a short circuit current of 0.7 amperes and an open circuit voltage, as extrapolated from volt-ampere curves, of about 1.5 volts. Author

N78-21442*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SYNTHESIS AND ANALYSIS OF PRECISE SPACEBORNE LASER RANGING SYSTEMS, VOLUME 1 Final Report
E. A. Paddon Aug. 1977 195 p refs 2 Vol.
(Contract NAS5-22955)
(NASA-CR-156727; MDC-E1729-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 20E

Measurement accuracy goals of 2 cm rms range estimation error and 0.003 cm/sec rms range rate estimation error, with no more than 1 cm (range) static bias error are requirements for laser measurement systems to be used in planned space-based earth physics investigations. Constraints and parameters were defined for links between a high altitude, transmit/receive satellite (HATRS), and one of three targets: a low altitude target satellite, passive (LATS), and active low altitude target, and a ground-based target, as well as with operations with a primary transmit/receive terminal intended to be carried as a shuttle payload, in conjunction with the Spacelab program. A.R.H.

N78-21443*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SYNTHESIS AND ANALYSIS OF PRECISE SPACEBORNE LASER RANGING SYSTEMS, VOLUME 2 Final Report
E. A. Paddon Feb. 1978 133 p 2 Vol.
(Contract NAS5-22955)
(NASA-CR-156728; MDC-E1729-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 20E

The performance capabilities of specific shuttle-based laser ranging systems were evaluated, and interface and support requirements were determined. The preliminary design of a shuttle-borne laser ranging experiment developed as part of the Spacelab program is discussed. Author

N78-21444*# Illinois Univ., Urbana. Radio Research Lab.
SPECKLE NOISE IN SATELLITE BASED LIDAR SYSTEMS Final Report
C. S. Gardner Dec. 1977 43 p refs
(Grant NsG-5049)
(NASA-CR-156723; RRL-PUBL-488) Avail: NTIS HC A03/MF A01 CSCL 20E

The lidar system model was described, and the statistics of the signal and noise at the receiver output were derived. Scattering media effects were discussed along with polarization and atmospheric turbulence. The major equations were summarized and evaluated for some typical parameters. Author

N78-21445*# Harvey Mudd Coll., Claremont, Calif. Engineering Clinic.
GENERATION OF A MONODISPERSED AEROSOL Final Report
Helma Schenck, Miles Mikasa, and Ralph DeVicariis Jun. 1974 61 p refs
(Contract NAS2-8143)
(NASA-CR-152133) Avail: NTIS HC A04/MF A01 CSCL 20E

The identity and laboratory test methods for the generation of a monodispersed aerosol are reported on, and are subjected to the following constraints and parameters; (1) size distribution; (2) specific gravity; (3) scattering properties; (4) costs; (5) production. The procedure called for the collection of information from the literature, commercial available products, and experts working in the field. The following topics were investigated: (1) aerosols; (2) air pollution -- analysis; (3) atomizers; (4) dispersion; (5) particles -- optics, size analysis; (6) smoke -- generators, density measurements; (7) sprays; (8) wind tunnels -- visualization. Author

N78-21446# Naval Research Lab., Washington, D. C.
HIGH ENERGY ION EXPANSION IN LASER-PLASMA INTERACTIONS Interim Report
R. Decoste and B. H. Ripin Dec. 1977 15 p refs
(AD-A049504; AD-E000094; NRL-MR-3669) Avail: NTIS HC A02/MF A01 CSCL 20/9

Measurements of energetic ion distributions produced from CD2 and CH2 targets are compared with a numerical model. The model describes the ambipolar expansion of hot electrons and two relatively cold ion species from a pressure gradient. For CD2 the plasma expansion is adequately represented by a single ion species, whereas for CH2 two ion fluids are required to account for the energy and the relative behavior of the high energy ion species. Author (GRA)

N78-21447# Massachusetts Inst. of Tech., Cambridge. Gas Turbine and Plasma Dynamics Lab.
FUNDAMENTAL MECHANISMS OF NONEQUILIBRIUM MHD LASING PHENOMENA Interim Report, 1 Mar. 1976 - 28 Feb. 1977
Jack L. Kerrebrock Oct. 1977 45 p refs
(Contract F44620-76-C-0067)
(AD-A049509; AFOSR-78-0003TR) Avail: NTIS HC A03/MF A01 CSCL 20/5

The fundamental mechanisms of lasing phenomena in MHD lasers are being studied by a combination of numerical modeling and a pulsed experimental simulation of the MHD flow laser. The numerical model includes all phenomena known to be of importance in nonequilibrium MHD plasmas, as well as the molecular kinetics of CO2 excitation and lasing. The kinetics of growth of ionization and of electrothermal instabilities are treated in detail. Except for the magnetic field, which is low by a factor of 4, these conditions are appropriate for MHD laser operation. The high magnetic field required for UxB induced lasing should not reduce the gain and probably will increase it for a given current density. It is concluded that plasma conditions suitable for MHD laser operation have been achieved in the pulsed simulation. The numerical modeling indicates that these conditions can be reached in an MHD flow laser. Author (GRA)

N78-21448# Avco-Everett Research Lab., Everett, Mass.
OPTICAL CONVERSION PROCESSES Final Report, 15 Sep. 1976 - 15 Nov. 1977
Daniel W. Trainor and S. A. Mani Jan. 1978 55 p refs
(Contract N00014-76-C-1162; ARPA Order 1806)
(AD-A049583) Avail: NTIS HC A04/MF A01 CSCL 20/5

The overall goal of this experimental program is to identify scalable techniques that efficiently convert existing high power UV lasers to lasers operating at longer wavelengths in the visible. Two nonlinear optical conversion techniques that we have considered are: stimulated Raman and parametric conversion

involving the KrF laser (248 nm). The objective of this contract is to suggest likely acceptor atoms for each technique which will thereby allow us to evaluate some of the key technical issues involved. These include: the production of acceptor candidates in the gas phase (typically refractory metals), the volumetric removal of the lower laser level in the stimulated Raman approach to prevent 'bottle necking' and allow recycling of the atoms during the laser pulse, and the consideration of overall system efficiency and scalability to high power.
Author (GRA)

N78-21449# SRI International Corp., Menlo Park, Calif. Molecular Physics Center.
STUDY OF METASTABLE RARE GAS COLLISIONS WITH HALOGENS Technical Report, Jun. 1976 - Dec. 1977
Keith T. Gillen and Donald C. Lorents 26 Jan. 1978 12 p refs
(Contract N00014-76-C-0734; SRI Proj. 5389)
(AD-A049829; SRI-MP-78-12) Avail: NTIS HC A02/MF A01 CSCL 07/2

An atomic beam scattering apparatus has been modified to allow detailed dynamic investigations of inelastic and reactive scattering between fast beams of metastable excited rare gases and halogen-containing target molecules. The first system investigated was Ar + I2. Detailed double-differential (angle and energy) measurements of the ion-pair formation channel have been completed and compared with the analogous reactions of alkali atoms with I2. In addition preliminary measurements of the elastic scattering angular distribution and the total destruction cross section have been made. Author (GRA)

N78-21450# Stanford Univ., Calif. Center for Materials Research.
GENERATION OF COHERENT VUV AND SOFT X-RAYS Semiannual Report, 1 Jul. - 31 Dec. 1977
S. E. Harris and J. F. Young Jan. 1978 26 p refs
(Contract N00014-75-C-1175; ARPA Order 2782)
(AD-A049858; SU-CMR-78-2; SU-GL-2770; SAR-5) Avail: NTIS HC A03/MF A01 CSCL 20/5

The goal of the program is the development of practical sources of coherent vacuum ultraviolet radiation. The primary effort was on the development of a new type of VUV light source based on spontaneous anti-Stokes scattering. This type of source may prove bright enough to serve as a pump for very short wavelength lasers. Details of the work are presented. In addition, investigation of factors limiting the efficiency of 3547 A to 1182 A generation in Xe was completed. A manuscript describing the results was accepted for publication in the IEEE Journal of Quantum Electronics. GRA

N78-21451# Naval Research Lab., Washington, D. C. Laser Plasma Branch.
LASER-FUSION STUDIES AT NRL: A REPORT TO ERDA Progress Report, Jul. 1975 - Sep. 1976
S. Bodner, R. Lehmberg, J. McMahon, R. McGill, B. H. Ripin, R. Decoste (Maryland Univ., College Park), D. Nagel, J. Stamper, R. Whitlock, and F. Young Oct. 1977 209 p refs
(AD-A050089; AD-E000076; NRL-MR-3591) Avail: NTIS HC A10/MF A01 CSCL 20/5

The laser fusion program concentrated its efforts in two areas: laser-plasma interaction and Nd-glass laser systems. Major experiments included a layered target, light scatter, fast ion studies with a newly-developed ion mass spectrometer, compressed probe beam including work on its third harmonic, compressed square pulses using a cesium cell, measurement of gain of glass in realistic pump geometry optimization of glasses, system quality and reliability improvements, automatic laser alignment, lead oxide vidicons. This report is divided into two sections, text and selected reprints, to encompass the range of NRL's research effort. GRA

N78-21452# Naval Research Lab., Washington, D. C. Optical Sciences Div.
DATA COMPENDIUM FOR ATMOSPHERIC LASER PROPAGATION STUDIES CONDUCTED AT CAPE CANAVERAL, FLORIDA, FEBRUARY - MAY 1977 Interim Report
A. Guttman, ed., T. H. Cosden, J. A. Curcio, J. A. Dowling, and D. H. Garcia Sep. 1977 124 p refs
(AD-A050094; NRL-MR-3611) Avail: NTIS HC A06/MF A01 CSCL 20/5

Atmospheric transmission measurements were carried out at the Cape Canaveral Air Force Station during the spring of 1977 by means of the NRL Infrared Mobile Optical Radiation Laboratory. Reduced data resulting from this effort are presented in this report for five laser wavelength regions (HeNe, Nd-YAG, DF, CO, CO2). Typical high-resolution transmission spectra included in this report were derived on the basis of Fourier transform spectroscopy. An extensive set of aerosol scattering coefficient data is reported for 15 visible wavelengths and is based on Koschmieder type measurements of the contrasts of distant targets. Results of extensive monitoring of the HDO path concentration with a gas filter correlation spectrometer show an abundance ratio significantly lower than the literature value of 0.03%. Results of in-situ meteorological measurements and aerosol particle size distribution samplings are also reported. Author

N78-21453# Naval Research Lab., Washington, D. C. Experimental Plasma Physics Branch.
A PRELIMINARY STUDY OF AEROSOL INITIATED CO2 LASER PRODUCED AIR SPARKS AND THEIR ABILITY TO GUIDE ELECTRICAL DISCHARGES Interim Report
J. R. Greig, R. E. Pechacek, R. F. Fernsler, I. M. Vitkovitsky, A. W. DeSilva, and D. W. Koopman Nov. 1977 19 p refs
(AD-A050097; AD-E000077; MRL-MR-3647) Avail: NTIS HC A02/MF A01 CSCL 20/5

The time development of air sparks initiated on aerosols near the focal region of a 1 kJ CO2 laser beam was studied. The spark at each aerosol produced a shock wave that expanded spherically at approximately 200,000 cm/sec during the 1.5 microsecs tail of the laser pulse. In time these spherical waves coalesced forming a turbulent cylindrical column from which a cylindrical blast wave separated. The turbulent cylindrical region was nearly stationary and was able to conduct electrical streamers at greatly enhanced velocities, at times as long as one millisecond after the laser pulse. Author

N78-21454# Litton Industries, Morris Plains, N.J. Airtron Div.
PREPARATION OF RARE EARTH DOPED LASER MATERIALS Annual Summary Report, 1 Nov. 1976 - 1 Nov. 1977
R. F. Belt and L. Drafall Jan. 1978 26 p refs
(Contract N00014-76-C-0770)
(AD-A049697) Avail: NTIS HC A03/MF A01 CSCL 20/5

This report describes the preparation of specific host materials doped with either Ce(3-) or Pr(3-). The materials were prepared by either a solid phase sintering, crystallization from a high temperature flux, or direct growth by the Czochralski method from a melt. Both the amount of dopant and particularly the valence state of cerium were important variables in attempting to control fluorescence. Samples were prepared for both spectral investigations and possible laser schemes in the blue-green region. Growth atmospheres and conditions were adjusted to yield the maximum amount of Ce(3-) in single crystals. YAG:Ce(3-) and YAlO3:Pr were prepared in fabricated forms of disks, rectangular rods or cylindrical rods. These crystals were then examined at other laboratories. Author (GRA)

N78-21455# Stanford Univ., Calif. Edward L. Ginzton Lab.
OPTICALLY PUMPED MERCURY LASERS FOR RING LASER GYROSCOPE APPLICATIONS Final Technical Report, 1 Jun. 1976 - 31 Aug. 1977
N. C. Holmes and A. E. Siegman Oct. 1977 79 p refs
(Grant AF-AFOSR-3043-76; AF Proj. 2305)
(AD-A049540; GL-2736; AFOSR-78-0023TR) Avail: NTIS HC A05/MF A01 CSCL 20/5

In this investigation, both the theoretical and practical aspects of the optically pumped CW mercury vapor laser at 546.1 nm have been explored. A rate-equation analysis was used to develop a quantitative model describing the nitrogen pressure dependence of laser power output and unsaturated gain. Careful measurements show the model to be in excellent agreement with the experiment. Measurements were also made as the pumping rates, bore diameter, and mercury density were varied. A qualitative treatment of the effects of high intensity pumping and radiation trapping is given, and this analysis is consistent with the observed behavior.

The nitrogen quenching rate across the laser transition was found to be 700,000 per sec per torr, and the pressure broadening of the green laser line was inferred to be 26.4 MHz/Torr. A detailed description of the experimental apparatus is given. Together with the experimental measurements, this work can provide a basis for the design of practical mercury laser systems. Author (GRA)

N78-21456# Avco-Everett Research Lab., Everett, Mass.
SMALL SCALE DISCHARGE STUDIES Semiannual Report, 1 Mar. - 31 Aug. 1977
J. A. Mangano, M. Rokni, J. H. Jacob, and J. C. Hsia 31 Aug. 1977 84 p refs
(Contract N00014-75-C-0062; ARPA Order 1806)
(AD-A049551) Avail: NTIS HC A05/MF A01 CSCL 20/5

In this article the rare gas fluoride lasers are discussed in detail. There is a significant interest in these lasers because they are the most efficient visible/UV lasers to date. The dominant formation kinetics of KrF^* and XeF^* in both discharges and e-beam pumped lasers are presented. Because of the ionic upper level the formation processes are rapid and conditions can be chosen such that the branching ratio into the KrF^* and XeF^* levels from both the ionic and metastable levels are unity. In e-beam pumping, a guide magnetic field enables the deposition of 70% of the beam energy into the optical volume. If two e-beams can be used 90% of the fast electron energy can be deposited into the optical volume. Discharge pumping has the potential of being more efficient than e-beam; however, key technical issues of discharge stability, and metastable production efficiency have to be addressed. Stabilization of the discharge appears possible if an external source of ionization is used. The quenching of the rare gas fluorides by two or three body processes have been carefully measured and analyzed. The three body quenching of KrF^* leads to the eventual formation of the excited triatomic $Kr2F^*$ which radiates in a broad-band centered at 410 mm. We have also determined that ionic and excited state absorption in the active media are large enough to impact the extraction efficiency of these lasers. GRA

N78-21457# Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md.
LASER HAZARDS BIBLIOGRAPHY, AUGUST 1977 EIGHTH EDITION
David H. Sliney, Nicholas Krial, and Carol Forbes Aug. 1977 141 p
(AD-A047606) Avail: NTIS HC A07/MF A01 CSCL 06/21

The Laser Hazards Bibliography consists of 1,838 references in the open literature broken into subject categories which relate to general biological effects, the eye, the skin, laser safety, laser propagation in the atmosphere, and laser measurements.
Author (GRA)

N78-21458# Hughes Research Labs., Malibu, Calif.
OPTICAL-MICROWAVE INTERACTIONS IN SEMICONDUCTOR DEVICES Quarterly Report, 17 Jun. - 14 Sep. 1977
Huan-Wun Yen and Mike Barnoski Oct. 1977 39 p refs
(Contract N00173-77-C-0156)
(AD-A050480; QR-1) Avail: NTIS HC A03/MF A01 CSCL 20/5

Theoretical and experimental studies of direct current modulation of semiconductor injection lasers were carried out. In the small signal approximation we found that the maximum usable frequency of modulation was limited to under 10 GHz. Experimentally we have demonstrated modulation of a single mode laser up to 3.4 GHz and were currently limited by our detection system. Optical injection locking experiments were carried out at low frequencies (2GHz). Injection locking was observed not only at fundamental frequencies but also at various subharmonics with less tolerance in frequency deviation. It is also possible to achieve simultaneous switching and phase locking in these oscillators. Author (GRA)

N78-21459# Stanford Univ., Calif. Edward L. Ginzton Lab.
ENERGY STORAGE AND TWO-PHOTON EXTRACTION FROM METASTABLE STATES Final Report, 19 Apr. 1974 - 30 Jun. 1977
Hiroshi Komine Nov. 1977 165 p refs
(Contract F44620-74-C-0039)
(AD-A050075; SU-GL-2753; AFOSR-78-0077TR) Avail: NTIS HC A08/MF A01 CSCL 20/5

This dissertation presents experimental studies on the energy storage characteristics of excited metastable species and theoretical analysis of optical energy extraction schemes based on stimulated two-photon transitions. The large energy capacity and long lifetime of metastable states offer attractive properties for generating high energy optical pulses for laser fusion and photochemical studies. Recent experimental results on the metastable states of molecular mercury illustrate some of the important properties of energy storage in a gaseous medium. In particular, collisional deactivation of excited metastable species by mutual two-body quenching and by molecular formation are discussed in relation to storage limitations. The optical extraction of energy stored in an inverted metastable system using stimulated two-photon transitions offers nonlinear characteristics not available in the ordinary laser amplifiers. Analytical expressions for the extraction efficiency of an ideal two-photon emission amplifier are derived. The experimental requirements for the proposed systems based on the calculated gains indicate that the currently available pumping methods and trigger laser sources may lead to a demonstration of two-photon amplification and energy extraction. GRA

N78-21460# Honeywell Corporate Material Sciences Center, Bloomington, Minn.
AN INVESTIGATION OF LASER INTERACTIONS Final Report, 15 Dec. 1972 - 30 Sep. 1977
John F. Ready Nov. 1977 69 p refs
(Contract F44620-73-C-0022)
(AD-A050049; AFOSR-78-0070TR) Avail: NTIS HC A04/MF A01 CSCL 20/5

This report describes work performed in a continuous program of investigations on the mechanisms by which high power pulsed CO2 laser radiation interacts with target surfaces. The experimental work has been performed using a pulsed CO2 TEA laser capable of delivering up to 1000Mw/sq cm to the target surface in a pulse of duration around 100 nanoseconds. Results described in this report include the following: The diffuse reflectivity of steel and titanium targets have been measured under varying conditions of TEA irradiation. The shock pressure coupled into metallic and potassium chloride targets by the laser-supported absorption wave has been measured interferometrically, and the results compared to catastrophic material failure in potassium chloride. The mass removal from plastic targets has been determined for various parameters of laser irradiation. Author (GRA)

N78-21461# Lockheed Missiles and Space Co., Palo Alto, Calif. Nuclear Sciences Lab.
EXPERIMENTAL STUDY OF THE INITIATION MECHANISM OF LASER SUPPORTED ABSORPTION WAVES Final Report, 1 Jan. 1975 - 30 Sep. 1977
T. E. Sharp Nov. 1977 79 p refs
(Contract F44620-75-C-0041)
(AD-A050054; LMSC-D566093; AFOSR-78-0068TR) Avail: NTIS HC A05/MF A01 CSCL 20/5

Mechanisms for prompt initiation of laser supported absorption waves are identified with their experimental consequences. A phenomenological theory of electron emission from metals under intense laser irradiation is discussed. A recent model for initiation of laser supported detonation waves which requires exceeding both irradiation and fluence thresholds is summarized. Design, construction, and testing of an apparatus including a target to permit measurement of electron emission with fast time resolution and an electron energy spectrograph and detector system are described. Experiments with 0.3 microsec pulses of 10.6 micrometers laser light with peak irradiance from 0.5 to 10 Mw/sq cm on stainless steel, titanium alloy, and aluminum targets in vacuum are reported. Data are given for the peak current density of electron emission as a function of laser irradiance. Roughening of the aluminum surface was found to increase electron emission and large emission currents were produced on an aluminum-coated multipoint microarray. Experiments with 0.1 ns pulses of 1.06 micrometers laser light with peak irradiance from 8 to 250 Mw/sq cm on various aluminum targets in vacuum are described. Data are given for the time dependence and peak current density of electron emission as a

function of laser irradiance and for the dependence of electron emission on laser polarization. GRA

N78-21462# Medical Coll. of Virginia, Richmond. Health Sciences Div.
BIOLOGICAL APPLICATIONS AND EFFECTS OF OPTICAL MASERS Progress Report, 1 Sep. 1976 - 31 Aug. 1977
W. T. Ham, Jr., A. M. Clarke, J. J. Ruffolo, and H. A. Mueller Jun. 1976 26 p
(Contract DADA17-72-C-2177; DA Proj. 3E7-62772-A-813) (AD-A050057; PR-677) Avail: NTIS HC A03/MF A01 CSCL 06/18

The pathology of photochemical lesions of the rhesus retina resulting from extended exposure (1000 s) to blue light (441 nm) as investigated with light and electron microscopy is described in detail for periods post-exposure ranging from one hour to ninety days. This photopathology correlates well with visual acuity performance in trained rhesus monkeys. The new 2500 W Xenon lamp system with quartz optics is described along with its capabilities for providing exposures in the near infrared, visible and near ultraviolet spectral regions. Preliminary data on 1000 eight ms pulses of 441 nm light at a one pulse per second repetition rate indicate that the radiant exposure required to produce a threshold lesion is lower than for cw exposure. Some preliminary exposures of the retina of aphakic monkeys support the thesis that the retina is quite sensitive to near ultraviolet damage. Also, repetitive exposures to blue light show that cumulative damage can occur in the retina.
Author (GRA)

N78-21463# Sandia Labs., Albuquerque, N. Mex.
TUNABLE DIODE LASER HETERODYNE SPECTROMETER FOR BALLOON-BORNE SOLAR RADIOMETRY IN THE STRATOSPHERE
C. E. Hackett Apr. 1977 46 p
(Contract EY-76-C-04-0789)
(SAND-77-0601) Avail: NTIS HC A03/MF A01

A wavelength tunable infrared laser heterodyne spectrometer was taken into the stratosphere as part of the instrumentation package on board the stratospheric scientific research balloon, STRATCOM VI, in order to obtain high resolution atmospheric absorption spectra of nitric oxide and water vapor by measurement of the attenuation of the solar radiance at approximately 5.24 microns. The development of the instrument system and the experimentation that characterized its performance is described. ERA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N78-21464 Washington Univ., Seattle.
A PERTURBATION METHOD FOR PREDICTING AMPLITUDES OF NONLINEAR WHEEL SHIMMY Ph.D. Thesis
James Thomas Gordon, Jr. 1977 226 p
Avail: Univ. Microfilms Order No. 7800928

A perturbation method is presented for the stability analysis of nonlinear shimmy models. Analytical expressions for the limit cycle amplitude and frequency were obtained as functions of the taxi velocity V and stability was examined. The solution method was applied to aircraft landing gear shimmy models which include a nonlinear (velocity squared) damper. The perturbation solution results are shown to agree well with those obtained by direct numerical integration of the nonlinear shimmy equations. Dissert. Abstr.

N78-21465 Oklahoma State Univ., Stillwater.
ANALYTICAL DETERMINATION OF THE BURMESTER LINES FOR CYLINDRIC-CYLINDRIC CRANKS Ph.D. Thesis
Amnon Fekete Vadasz 1977 113 p
Avail: Univ. Microfilms Order No. 78-01357

The development of an analytical expression which gives the ratios of two of the three direction cosines of the Burmester lines for C-C cranks was examined. The procedure involved in obtaining the Burmester lines is based on the application of the relationships for equivalent screw triangles formed by the binary crank and the screws describing the finitely separated positions. The four equivalent screw triangles formed by the binary crank and the screws yield a total of four equations relating the direction cosines and angles of rotation of the rigid body about the screws. Since there are only three independent relationships between direction cosines and angles of rotation, the set of four compatible equations yields two conditions forcing two third-order determinants to vanish. Expansion of these determinants yields two cubic cones describing the space analogs of the planar center-point curves. Dissert. Abstr.

N78-21466 Wisconsin Univ., Madison.
MULTIVARIABLE COMPUTER CONTROL OF A GAS METAL ARC WELDING PROCESS Ph.D. Thesis
Richard Alan Lund 1977 308 p
Avail: Univ. Microfilms Order No. 77-23719

An investigation of the concept and feasibility of controlling a gas metal arc (GMA) welding process with a digital process control computer is described. The CO2 welding of steel in the globular transfer mode is featured. A dynamic model for the GMA process was derived for controller design purposes. A means for relating material and energy transfer in the process to process adjustments was established. A strategy for controlling the process was derived from the fundamental requirements for a good weld. These requirements are based on the flow of energy and filler material into the weld pool and must flow at the proper level in a sufficiently regular manner. The four variables involved were reduced to three independent controlled variables through consideration of drop transfer across the arc. Dissert. Abstr.

N78-21467 South African Bureau of Standards, Pretoria.
CODE OF PRACTICE FOR WELDING. PART 5: WELDERS' COMPETENCE TESTS FOR MANUAL OXY-ACETYLENE, MANUAL METAL-ARC, MANUAL GAS-SHIELDED TUNGSTEN-ARC, AND MANUAL GAS-SHIELDED METAL-ARC WELDING OF MILD STEEL (CARBON STEEL) AND MEDIUM HIGH TENSILE STEEL PIPELINES AND PIPE ASSEMBLIES
Nov. 1976 70 p In ENGLISH and AFRIKAANS Revised Supersedes SABS-044-Part-5-1972
(SABS-044-Pt/Deel-5-1976-Rev-1; ISBN-0-626-04016-7) Copyright. Avail: Issuing Activity

Testing procedures to be followed in assessing a welder's competence to weld pipelines and pipe assemblies (of outside diameter not exceeding 610 mm) made of mild steel (carbon steel) or medium high tensile steel having an ultimate tensile strength (in both cases) not exceeding 515 MPa are presented. This section of the code applies to manual oxy-acetylene, manual metal-arc, manual gas-shielded tungsten-arc, and manual gas shielded metal-arc welding and any combinations of these processes (e.g. root run by gas-shielded tungsten-arc process and capping runs by gas-shielded metal-arc process) and makes provisions for two levels of welders' competence. Author

N78-21468 South African Bureau of Standards, Pretoria.
CODE OF PRACTICE FOR WELDING. PART 7: WELDERS' COMPETENCE TESTS FOR MANUAL METAL-ARC, MANUAL INERT GAS-SHIELDED TUNGSTEN-ARC, AND MANUAL INERT GAS-SHIELDED METAL-ARC WELDING OF AUSTENITIC STAINLESS AND AUSTENITIC HEAT RESISTING STEEL PIPELINES AND PIPE ASSEMBLIES
Nov. 1976 60 p In ENGLISH and AFRIKAANS
(SABS-044-Pt/Deel-7-1976) Copyright. Avail: Issuing Activity

The testing procedures which should be followed in order to assess a welder's competence to weld austenitic stainless and austenitic heat resisting steel pipelines and pipe assemblies (of outside diameter not exceeding 610 mm) are described. Manual metal-arc, manual inert gas-shielded tungsten-arc, and manual inert gas-shielded metal-arc welding and any combination of these processes (e.g. root run by inert gas-shielded tungsten-arc process and capping runs by metal-arc pocess) are covered including two levels of welders' competence. Author

N78-21469*# California State Univ., Northridge.
BALL TO SEPARATOR CONTACT FORCES IN ANGULAR

CONTACT BALL BEARINGS UNDER THRUST AND RADIAL LOADS Final Report
Lester J. Nypan Apr. 1978 110 p refs
(Grant NsG-3065)
(NASA-CR-2976) Avail: NTIS HC A06/MF A01 CSCL 13I

Experimental data are reported on ball to cage contact forces in a 110 mm bore ball bearing operating at speeds to 12,000 rpm under radial and thrust loads. Information is also reported on cage to inner race land contact force, cage to inner race land clearance, and cage to shaft speed ratios. Author

N78-21470*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHARACTERIZATION OF WEAR DEBRIS GENERATED IN ACCELERATED ROLLING-ELEMENT FATIGUE TESTS
William R. Jones, Jr. and Richard J. Parker Apr. 1978 28 p refs
(NASA-TP-1203; E-9260) Avail: NTIS HC A03/MF A01 CSCL 13I

A ferrographic analysis was used to determine the types and quantities of wear debris generated during accelerated rolling contact fatigue tests. The five-ball rolling contact fatigue tester was used. Ball specimens were made of a corrosion resistant, high-temperature bearing steel. The lubricant was a superrefined naphthenic mineral oil. Conditions included a maximum Hertz stress of 5.52 10 to the 9th power Pa and a shaft speed of 10,000 rpm. Four types of wear debris were observed: (1) normal rubbing wear particles, (2) fatigue microspall particles, (3) spheres, and (4) friction polymer deposits. The characterization of wear debris as a function of time was of limited use in predicting fatigue failures in these accelerated tests. Author

N78-21471*# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
LIGHTWEIGHT, LOW COMPRESSION AIRCRAFT DIESEL ENGINE
T. L. Gaynor, M. S. Bottrell, C. D. Eagle, and C. F. Bachle Jul. 1977 103 p refs
(Contract NAS3-20051)
(NASA-CR-135300) Avail: NTIS HC A06/MF A01 CSCL 21G

The feasibility of converting a spark ignition aircraft engine to the diesel cycle was investigated. Procedures necessary for converting a single cylinder GTS10-520 are described as well as a single cylinder diesel engine test program. The modification of the engine for the hot port cooling concept is discussed. A digital computer graphics simulation of a twin engine aircraft incorporating the diesel engine and Hot Fort concept is presented showing some potential gains in aircraft performance. Sample results of the computer program used in the simulation are included. Author

N78-21472*# Mechanical Technology, Inc., Latham, N. Y.
HYDRODYNAMIC AIR LUBRICATED COMPLIANT SURFACE BEARING FOR AN AUTOMOTIVE GAS TURBINE ENGINE. 1: JOURNAL BEARING PERFORMANCE Final Report
D. Ruscitto, J. McCormick, and S. Gray Apr. 1978 145 p refs Prepared for DOE
(Contracts NAS3-19427; EC-77-A-31-1040)
(NASA-CR-135368; CONS/9427-1) Avail: NTIS HC A07/MF A01 CSCL 20E

A 38.1 mm (1.5 inch) diameter Hydresil Compliant Surface Air Lubricated Journal Bearing was designed and tested to obtain bearing performance characteristics at both room temperature and 315 C (600 F). Testing was performed at various speeds up to 60,000 rpm with varying loads. Rotating sensors provided an opportunity to examine the film characteristics of the compliant surface bearing. In addition to providing minimum film thickness values and profiles, many other insights into bearing operation were gained such as the influence of bearing fabrication accuracy and the influence of smooth foil deflection between the bumps. Author

N78-21473*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROLLING-ELEMENT FATIGUE LIFE OF AISI M-50 AND 18-4-1 BALLS
Richard J. Parker and Erwin V. Zaretsky Apr. 1978 19 p refs
(NASA-TP-1202; E-9350) Avail: NTIS HC A02/MF A01 CSCL 13I

Rolling element fatigue studies were conducted with AISI M-50, EFR 18-4-1, and VAR 18-4-1. Groups of 12.7 mm (1/2-in) diameter balls of each material were tested in the five ball fatigue tester. Test conditions included a load of 1540 N (347 lbf) giving a maximum Hertz stress of 5520 MPa (800 000 psi), a shaft speed of 10,700 rpm, and a contact angle of 30 deg. Tests were run at a race temperature of 339 K (150 F) with a type 2 ester lubricant. The rolling element fatigue life of AISI M-50 was not significantly different from that of EFR 18-4-1 or VAR 18-4-1 based on a statistical comparison of the test results. Author

N78-21474# Solar Turbines International, San Diego, Calif.
TEST EVALUATION OF STATIONARY AND ROTATING DIFFUSERS FOR A HIGH PRESSURE RATIO RADIAL COMPRESSOR Final Report
Colin Rogers and Lee Blinman Oct. 1977 71 p
(Contract DAAG53-76-C-0107)
(AD-A049856; ER-2602) Avail: NTIS HC A04/MF A01 CSCL 13/7

The design of a free rotating vaneless/vaned diffuser (F.R.D.) for a nominal 1.9 pps, high pressure ratio, single stage radial compressor was completed, together with a comparative conventional stationary vaneless/vaned optimum channel diffuser. Both types of diffuser were subsequently fabricated and individually installed in an existing turbodrive compressor rig for comparative performance evaluation. At 100% corrected design impeller speed, equal to 62,000 rpm, the peak pressure ratio and adiabatic efficiency for the stationary and F.R.D. systems were 7.91 and 72.6% compared to 7.43 and 70%, respectively. Impeller efficiency was not repeatable and reduced 3.8% at design speed with the F.R.D. installed, probably as a result of different radial clearance settings. Overall peak vaneless/vaned diffuser static pressure recovery was essentially the same (0.61) at design speed with either the stationary or F.R.D. systems.Author (GRA)

N78-21475# Purdue Research Foundation, Lafayette, Ind.
FLO-PEELING AND OTHER ALTERNATIVES TO CONVENTIONAL TURNING
O. D. Lascoe Oct. 1977 124 p refs
(Contract DAAF03-73-C-0012)
(AD-A050123; SARRI-EN-TR-78-02) Avail: NTIS HC A06/MF A01 CSCL 13/8

Machining of 4140 alloy by flo-peeling, and by related turning, milling and grinding was evaluated using self-propelled and power-driven, single-edge and multiple-edge, cutting tools. The cutting tools included HSS (high-speed-steel) and carbide discs, HSS and carbide milling cutters, and abrasive grinding wheels. Tests were conducted using 15 HP and 20 HP lathes with a single cutter head mounted on the lathe cross-slide, and with a multiple-head assembly mounted on the carriage. GRA

N78-21476# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
STUDY OF SURFACE FATIGUE WEAR BY EXOELECTRON EMISSION Final Report
Ernest Rabinowicz and Donald M. Boyd 30 Dec. 1977 80 p refs
(Contract DAHC04-74-C-0028)
(AD-A049927; ARO-11889.2-E) Avail: NTIS HC A05/MF A01 CSCL 13/9

An investigation of surface fatigue wear of bearing balls was carried out, using exoelectrons to monitor crack growth prior to spalling. The balls were run in a Barwell 4-ball surface fatigue wear tester, and periodically removed from the tester, cleaned to remove their oil film, transferred to a special vacuum chamber, and illuminated with ultraviolet light. The emitted exoelectrons originating at new surface area generated during fatigue testing were detected by an electron multiplier. By rotating the ball and measuring the exoelectron emission as a function of position, the sources of the emission could be localized to within the resolution of the scanning spot, 0.08 mm. GRA

N78-21477# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
ANALYTICAL MODELS AND EXPERIMENTAL STUDIES OF CENTRIFUGAL PUMP PERFORMANCE IN TWO-PHASE FLOW. KEY PHASE REPORT
David Gordon Wilson, Tak-Chee Chan, Albert L. Goldfinch, and Raymond D. Zegley Jan. 1977 182 p
(EPRI Proj. 493)
(EPRI-NP-170) Avail: NTIS HC A09/MF A01

A method of modeling the two phase performance of pumps is proposed and given preliminary evaluation. Change in enthalpy or head across the pump rotor is given by the Euler equation, and losses in two phase flow are shown to be principally a function only of losses in single phase flow at the same flow coefficient, of the flow coefficient itself, and of the void fraction and flow regime at pump inlet. The model correlates the data from different pump tests in all four quadrants. Some of these two phase data were taken on a small air-water test rig in order to study the effects of changing flow regimes on pump performance. A mechanism by which a pump operating in the first quadrant can operate in a high-loss, stable manner through the migration of gas or vapor bubbles upstream from rotor outlet to rotor inlet through the action of the intense centrifugal field and remain blanketing the rotor even after the inlet flow returns to the fully liquid condition was identified. ERA

N78-21478# Babcock and Wilcox Co., Lynchburg, Va. Nuclear Power Generation Div.
A 1/3 SCALE AIR-WATER PUMP PROGRAM, ANALYTICAL PUMP PERFORMANCE MODEL. VOLUME 1: KEY PHASE REPORT
J. J. Cudlin Oct. 1977 66 p refs
(EPRI Proj. 598)
(EPRI-NP-160-Vol-1) Avail: NTIS HC A04/MF A01

A model for reactor coolant pump performance during two phase flow is described. The model was based on steady-state tests of a one-third scale reactor coolant pump using air-water flows. The single- and two-phase homologous curve parameters calculated from the test data are related through multiplier functions of the pump average void fraction. The air-water head and torque multipliers are implemented in a homologous curve model for transient reactor coolant pump behavior. ERA

N78-21479# Chrysler Corp., Detroit, Mich.
BASELINE GAS TURBINE DEVELOPMENT PROGRAM Quarterly Progress Report
F. W. Schmidt, comp. and C. E. Wagner, comp. 30 Apr. 1977 261 p
(Contract EY-76-C-02-2749)
(COO-2749-18) Avail: NTIS HC A12/MF A01

Initial running of the upgraded engine took place on July 13, 1976. The engine proved to be mechanically sound, but was also 43% deficient in power. A continuing corrective development effort has to date reduced the power deficiency to 32%. Compressor efficiency was increased 2 points by changing to a 28-channel diffuser and tandem deswirl vanes; improved processing of seals has reduced regenerator leakage from about 5 to 2.5% of engine flow; a new compressor turbine nozzle has increased compressor turbine stage efficiency by about 1 point; and adjustments to burner mixing ports have reduced the pressure drop from 2.8 to 2.1% of engine pressure. ERA

N78-21480# Westinghouse Electric Corp., Lester, Pa. Generation Systems Div.
HIGH TEMPERATURE TURBINE TECHNOLOGY PROGRAM. PHASE 1: PROGRAM AND SYSTEM DEFINITION. TOPICAL REPORT: LOW BTU GAS COMBUSTOR TECHNOLOGY DEVELOPMENT PLAN
Feb. 1977 117 p refs
(Contract EX-76-C-01-2290)
(FE-2290-26) Avail: NTIS HC A06/MF A01

An advanced canannular type combustor intended for integration with the high temperature turbine subsystem in a coal gasification combined cycle power plant was selected for development to the status of technology readiness after a preliminary design evaluation of three different concepts. Plans for the design, fabrication, and testing of three initial versions of the advanced concept combustor as a means of design optimization are described. To assure the ultimate feasibility of economically producing large-scale Lamilloy combustors, the recommended program includes work to develop the improved fabrication techniques required. A comprehensive analytical evaluation is planned to explore the feasibility of additional advanced design features which will further reduce combustor cooling-air requirements as necessary to permit firing-temperature growth to the 3000 F level. ERA

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N78-21481 Illinois Inst. of Tech., Chicago.
DESIGN OF INTERACTIVE MANUFACTURING AND QUALITY SYSTEMS SUBJECT TO INSPECTION ERROR USING DYNAMIC PROGRAMMING Ph.D. Thesis
Allen C. Endres 1977 189 p
Avail: Univ. Microfilms Order No. 7800861

The decision variables associated with the sampling plans were sample sizes and acceptance numbers for the lot by lot sampling plans and sampling frequencies and clearance numbers for the continuous sampling plans. In addition, the desired process average was assumed specifiable for the vendor and all manufacturing stages. The systems considered range from a single manufacturing stage placed between two inspection stages, to an interconnected series of inspection and manufacturing stages for single component systems. An additional aspect of the decision models was the introduction of probabilities of decision errors committed by the inspectors. Means were provided for addressing this facet of any real world inspection environment of an interrelated system. Dissert. Abstr.

N78-21482# Naval Postgraduate School, Monterey, Calif.
THE EFFECT OF MODELING DEPTH ON RELIABILITY PREDICTION FOR SYSTEMS SUBJECT TO A PHASED MISSION PROFILE
J. D. Esary Jul. 1977 26 p refs
(AD-A050246; NPS55-77-32) Avail: NTIS HC A03/MF A01 CSCL 14/4

The term 'phased mission profile' describes a situation in which the factors that influence the longevity of a system change in the course of a sequence of distinct, successive periods of time which are the mission 'phases'. Phased mission profiles tend to be associated with more general phased missions, in which there can also be changes in the system configuration that is relevant to mission success, but many systems with a stable configuration are exposed to phased mission profiles. Predictions of the probability of mission success for a system typically result from combining predicted probabilities of mission success for its components according to logic model for the system's configuration. We investigate the effect that the depth to which the logic model is carried has on predictions, when the predictions at the component level are made using a 'standard' methodology. Author (GRA)

N78-21483# Oak Ridge National Lab., Tenn.
LOOSE-PARTS MONITORING: PRESENT STATUS OF THE TECHNOLOGY, ITS IMPLEMENTATION IN US REACTORS, AND SOME RECOMMENDATIONS FOR ACHIEVING IMPROVED PERFORMANCE
R. C. Kryter, C. W. Ricker, and J. E. Jones (Tenn. Univ., Knoxville) 1977 6 p Presented at Specialists Meeting on Reactor Noise, Gatlinburg, Tenn., 19 Sep. 1977
(Contract W-7405-eng-26)
(CONF-770902-5) Avail: NTIS HC A02/MF A01

An assessment of the technical development status of loose-parts monitoring systems (LPMS) and their performance record to date in commercial light-water-cooled nuclear reactor plants was made during the spring of 1977, using an on-site personal interview and equipment demonstration approach. The study revealed that while presently demonstrated LPMS technology does indeed provide a capability for detecting the

presence of those relatively massive loose parts that would likely constitute a serious operational or safety hazard to the plant, it unfortunately affords little information useful to the determination of the part's safety significance and has not yet attained the levels of sophistication and reliability ordinarily associated with safety systems. ERA

N78-21484# Oak Ridge National Lab., Tenn.
EVALUATION OF FLAW INDICATIONS BY ULTRASONIC PULSE AMPLITUDE AND PHASE SPECTROSCOPY
Eberhard Nabel 1977 12 p refs Transl. into ENGLISH from Materiale Pruefung (Duesseldorf), v. 19, no. 2, Feb. 1977 p 58-64
(ORNL-tr-4355) Avail: NTIS HC A02/MF A01

In nondestructive testing with ultrasound there were no criteria which made it possible to answer questions as to nature, size, and orientation in a sufficient unambiguous manner. The echo amplitude which was used in many cases as the sole measure for evaluation depends on orientation and size of the reflector, as well as on the frequency and the bandwidth of the transducer. In practice these dependencies cannot be taken into account. The results described were found during research on methods for unambiguous evaluation of echoes by spectrum analysis according to amplitude and phase and by deconvolution of the signals. ERA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N78-21485 Virginia Univ., Charlottesville.
DYNAMIC RESPONSE OF LINEAR DAMPED CONTINUOUS STRUCTURAL MEMBERS Ph.D. Thesis
John Sigmund Strenkowski 1977 244 p
Avail: Univ. Microfilms Order No. 7800446

Modal analysis was used extensively as a solution technique to determine the dynamic response of structural members for both undamped discrete and undamped continuous linear systems. For damped continuous structural members, the use of modal analysis was largely restricted to simple viscous damping, especially so-called proportional viscous damping. The literature also indicated that use of this technique to uncouple members with other types of damping, such as general viscous, viscoelastic material, and structural damping has been limited to only a few structural member applications. A comprehensive theory is presented for the dynamic response of continuous damped structural members using a modal analysis. The theory involved a general formulation which depended only on the equations of motion and is independent of any particular structural member. Dissert. Abstr.

N78-21486 Illinois Inst. of Tech., Chicago.
THE STRESS CLOCK FUNCTION IN VISCOELASTICITY Ph.D. Thesis
Arsalan Skokooh 1977 199 p
Avail: Univ. Microfilms Order No. 7800883

The concept of the stress clock function is introduced. A scalar-valued quantity U depending on the stress clock function and the relative deformation gradient is defined. Employing the principles of isotropy and the virtual work, the constitutive equations relating U and the stress are derived. Shear viscosity and the extensional viscosity for both linear and non-linear theory are discussed. The theory developed is utilized to solve the problem of an elastic-visco-plastic pressurized cylinder. It is shown that the behavior of the stress clock function is the governing factor in order for part of the tube (radially outward) to become viscoelectric. Dissert. Abstr.

N78-21487 Tennessee Technological Univ., Cookeville.
THE TORSIONAL ANALYSIS OF STEADY STATE AND TRANSIENT WAVE PROPAGATION IN ELASTIC CYLINDERS Ph.D. Thesis
Chin-Nan Ni 1975 103 p
Avail: Univ. Microfilms Order No. 7801450

A number of different investigations concerning torsional wave propagation in elastic materials were developed. The propagation of transient waves in a semi-infinite circular rod was examined in detail, both analytically and numerically. A double-integral transform was presented as a means of formulating an exact solution in which a torsional shear stress was applied to the end surface for a cylindrical rod. The numerical solution was obtained based upon the method of characteristics. The resulting compatibility equations were in a form suitable for solution by a method of finite differences. Results were given for the particle velocity and stress components. Based on the theory of characteristics, the propagation of wave fronts in a nonhomogeneous, anisotropic cylinder was described. Expressions for the position of the wave front and the ray geometry were presented. Dissert. Abstr.

N78-21488# Illinois Univ. at Chicago Circle, Chicago.
ASYMPTOTICALLY DERIVED CYLINDRICAL SHELL THEORIES WITH APPLICATION TO ANISOTROPIC COMPOSITE MATERIALS Ph.D. Thesis
Daryl Lee Logan 1977 220 p
Avail: Univ. Microfilms Order No. 77-32749

First-order thin shell and third-order thick shell correction theories were formulated for nonhomogeneous, anisotropic, circular cylindrical elastic shells. The procedure used is that of employing the method of asymptotic expansions in terms of a small parameter in conjunction with Reissner's variational principle. Results are presented for both thin and thick anisotropic single layer and laminated cylinders possessing various manners of layering. The significant contribution of the higher order correction theory was indicated by either a comparison with an exact elasticity solution or with the results from a uniformly valid theory. When applicable, the edge effect behavior for various beam stiffnesses, angles of orientation and degrees of anisotropy are discussed. The procedure of superimposing specialized theories and the simplicity in the solution state gained by doing so were illustrated. Dissert. Abstr.

N78-21489*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A BIAXIAL METHOD FOR INPLANE SHEAR TESTING
Harold G. Bush and Tanchum Weller (Technion - Israel Inst. of Tech.) Apr. 1978 23 p refs
(NASA-TM-74070) Avail: NTIS HC A02/MF A01 CSCL 20K

A biaxial method for performing inplane shear tests of materials using a shear frame is described. Aluminum plate and sandwich specimens were used to characterize the uniformity of shear strain imparted by the biaxial method of loading as opposed to the uniaxial method. The inplane stiffening effect of aluminum honeycomb core was determined. Test results for (+ or - 45) graphite-epoxy laminate are presented. Some theoretical considerations of subjecting an anisotropic material to a uniform shear deformation are discussed. Author

N78-21490*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SIMPLE TORSION TEST FOR SHEAR MODULI DETERMINATION OF ORTHOTROPIC COMPOSITES
H. Theodore Sumsion and Yapa D. S. Rajapakse Apr. 1978 15 p refs Presented at 2d Intern. Conf. on Composite Mater., Toronto, 16-20 Apr. 1978
(NASA-TM-78485; A-7418) Avail: NTIS HC A02/MF A01 CSCL 20K

By means of torsion tests performed on test specimens of the same material having a minimum of two different cross sections (flat sheet of different widths), the effective in-plane (G13) and out-of-plane (G23) shear moduli were determined for two composite materials of uniaxial and angleply fiber orientations. Test specimens were 16 plies (nominal 2 mm) thick, 100 mm in length, and in widths of 6.3, 9.5, 12.5, and 15.8 mm. Torsion tests were run under controlled deflection (constant angle of twist) using an electrohydraulic servocontrolled test system. In-plane and out-of-plane shear moduli were calculated from an equation derived in the theory of elasticity which relates applied torque, the torsional angle of twist, the specimen width/thickness ratio, and the ratio of the two shear moduli G13/G23. Results

demonstrate that torsional shear moduli, G23 as well as G13, can be determined by simple torsion tests of flat specimens of rectangular cross section. Neither the uniaxial nor angleply composite material were transversely isotropic. Author

N78-21491*# Old Dominion Univ. Research Foundation, Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
ANALYTICAL AND NUMERICAL INVESTIGATION OF STRUCTURAL RESPONSE OF COMPLIANT WALL MATERIALS Final Report
G. L. Goglia and R. Balasubramanian Mar. 1978 52 p refs (Grant NsG-1236)
(NASA-CR-156151) Avail: NTIS HC A04/MF A01 CSCL 20K

Theoretical analysis of an electrostatically driven wall system for a compliant wall drag reduction program is reported. The electrostatic wall system is capable of producing deflections of many orders greater than the thicknesses and at small wavelengths. An intermediate large response theory was used for structural analysis. The theoretical predictions were compared to bench test results, and good agreement between the two was obtained. The effects of aerodynamic loads and perturbation electric fields on the theoretical solutions were considered. It was shown that for very small wavelengths (approximately 2 mm) the aerodynamic effects can be estimated using potential theory without loss of accuracy, and the perturbation electric fields do not affect solutions as long as the deflections are less than one percent of the wavelength. Resonance effects for this type of structure were shown to be fairly small. Author

N78-21492# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
ENVIRONMENTAL EFFECTS ON CRACK GROWTH IN FLIGHT-SIMULATION TESTS ON 2024-T3 AND 7075-T6 MATERIAL
J. Schijve, F. A. Jacobs, and P. J. Tromp 1976 57 p refs
(NLR-TR-76104-U; ICAF-995) Avail: NTIS HC A04/MF A01

Flight-simulation tests based on a standardized gust load spectrum were carried out in normal air, very dry air, and salt water. In all cases a significant effect of the environment was found. The more severe flights caused noticeable crack growth delays, thus having a predominant effect on crack growth. Technical implications of the test results are discussed. Author

N78-21493*# Boeing Aerospace Co., Seattle, Wash.
ANALYSIS AND TEST OF DEEP FLAWS IN THIN SHEETS OF ALUMINUM AND TITANIUM. VOLUME 1: PROGRAM SUMMARY AND DATA ANALYSIS Contractor Report, Jul. 1976 - Dec. 1977
R. W. Finger Apr. 1978 189 p refs 2 Vol.
(Contract NAS3-19697)
(NASA-CR-135369; D180-24613-1) Avail: NTIS HC A09/MF A01 CSCL 20K

Six thicknesses of 2219-T87 aluminum base metal surface flaw and center crack specimens ranging from 9.53 to 0.635 mm (0.375 to 0.025 inch) were tested at temperatures ranging from 295K to 20K. Additionally, 6A1-4V STA titanium base metal specimens were tested in three thicknesses 3.18, 2.03, and 1.02 mm (0.125, 0.080 and 0.040 inch) at room temperature. All tests were conducted on uniaxial specimens. Results were analyzed and compared with previously developed data to establish a criterion for proof testing thin walled pressure vessels. The data analysis and exact flaw size dimensions are presented. Author

N78-21494*# Boeing Aerospace Co., Seattle, Wash.
ANALYSIS AND TEST OF DEEP FLAWS IN THIN SHEETS OF ALUMINUM AND TITANIUM. VOLUME 2: CRACK OPENING DISPLACEMENT AND STRESS-STRAIN DATA Contractor Report, Jul. 1976 - Dec. 1977
R. W. Finger Apr. 1978 213 p 2 Vol.
(Contract NAS3-19697)
(NASA-CR-135370; D180-24613-2) Avail: NTIS HC A10/MF A01 CSCL 20K

Static fracture tests were performed on surface flawed specimens of aluminum and titanium alloys. A simulated proof overload cycle was applied prior to all of the cyclic tests. Variables included in each test series were flaw shapes and thickness. Additionally, test temperature was a variable for the aluminum test series. The crack opening displacement and stress-strain data obtained are presented. Author

N78-21495*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SHEAR STRENGTH OF FILLET WELDS IN ALUMINUM ALLOY 2219
Charles V. Lovoy Apr. 1978 26 p refs
(NASA-TM-78168) Avail: NTIS HC A03/MF A01 CSCL 20K

Fillet size is discussed in terms of theoretical or design dimensions versus as-welded dimensions, drawing attention to the inherent conservatism in the design load sustaining capabilities of fillet welds. Emphasis is placed on components for the solid rocket motor, external tank, and other aerospace applications. Problems associated with inspection of fillet welds are addresses and a comparison is drawn between defect counts obtained by radiographic inspection and by visual examination of the fracture plane. Fillet weld quality is related linearly to ultimate shear strength. Correlation coefficients are obtained by simple straight line regression analysis between the variables of ultimate shear strength and accumulative discontinuity summation. Shear strength allowables are found to be equivalent to 57 percent of butt weld A allowables (F sub tu.) Author

N78-21496# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF EQUIVALENT REINFORCEMENT OF HOLES IN A SHELL
A. Iu. Gleba and A. A. Galasi [1977] 6 p refs Transl. into ENGLISH from Prikl. Mekhan. (USSR), v. 13, no. 9, 1977 p 40-45
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

An elastically deformed ring is proposed for reinforcing holes in shells in the interest of more acceptable geometric considerations of the equivalent ring. The problem of selecting an equivalent ring reduces to finding the stiffness characteristics of the ring for a known load and deformation. Kirchhoff and Hooke's law relationships are used to show that the stiffness of the elastically deformed equivalent ring depend on the fundamental stress-strain state of the shell, the hole shape, and the components of preliminary deformation of the ring. Author

N78-21497# Naval Research Lab., Washington, D. C.
TRANSIENT RESPONSE OF TWO FLUID-COUPLED SPHERICAL ELASTIC SHELLS TO AN INCIDENT PRESSURE PULSE Interim Report
H. Huang 23 Dec. 1977 29 p refs
(AD-A049443; AD-E000099; NRL-8185) Avail: NTIS HC A03/MF A01 CSCL 20/11

The transient response of a system of two concentric spherical elastic shells coupled by an ideal fluid and impinged by an incident plan pressure pulse is analyzed. The classical techniques of separation of variables and Laplace transforms are employed for solving the wave equations governing the fluid motions and the shell equations of motion. A scheme of iterative convolution was devised for the inversion of the Laplace transforms that facilitate the calculation of accurate transient solutions of the response of the shells. A sample calculation of shell responses was performed and results are compared to the case in which the outer shell is absent. This set of results demonstrates that a thin outer shell tends to be transparent to the incident pulse. Author (GRA)

N78-21498# Cornell-Sydney Univ. Astronomy Center, Sydney (Australia).
THE TIME TO FAILURE OF CABLES SUBJECTED TO RANDOM LOADS Technical Report, 1 May 1976 - 30 Jun. 1977
H. M. Taylor Sep. 1977 34 p refs
(Contracts N00014-76-C-0790; NSF ENG-75-00570)
(AD-A049585) Avail: NTIS HC A03/MF A01 CSCL 13/5

The effect on cable reliability of random cyclic loading such as that generated by the wave induced rocking of ocean vessels deploying these cables is examined. A simple model yielding explicit formulas is first explored. In this model, the failure time of a single element under a constant load is assumed to be exponentially distributed, and the random loadings are a two state stationary Markov process. The effect of load on failure

time is assumed to follow a power law breakdown rule. In this setting, explicit results concerning the distribution of bundle or cable failure time, and especially the mean failure time, are obtained. Where the fluctuations in load are frequent relative to cable life, such as may occur in long-lived cables, it is shown that randomness in load tends to decrease mean cable life, but it is suggested that the reduction in mean life often can be restored by modestly reducing the base load on the structure or by modestly increasing the number of elements in the cable.
GRA

N78-21499# Brown Univ., Providence, R. I. Div. of Engineering.

FINITE VISCOPLASTIC DEFLECTIONS OF AN IMPULSIVELY LOADED PLATE BY THE MODE APPROXIMATION TECHNIQUE

Paul S. Symonds and Choon T. Chon Sep. 1977 43 p refs
(Contract N00014-75-C-0860; Grant NSF ENG-74-21259)
(AD-A049827; N00014-0860/5) Avail: NTIS HC A03/MF A01 CSCL 20/11

The application of the mode approximation technique to a fully clamped plate is here described. Mode solutions for finite deflections are obtained from a sequence of instantaneous modes. Master solutions for chosen initial velocity amplitudes are constructed in nondimensional form. These depend weakly on a parameter of viscoplastic material behavior and size of structure, and so can be applied to a variety of loadings and structures. Finding each instantaneous mode shape and acceleration constitutes an eigen-problem, solved by finite elements with iterations. Comparisons with recent tests on steel and titanium plates are discussed in some detail. Author (GRA)

N78-21500# Agbabian Associates, El Segundo, Calif.

PULSE APPLICATIONS AND PARAMETER IDENTIFICATION FOR US NAVY MEDIUM-WEIGHT SHOCK MACHINE Summary Report

F. B. Safford Nov. 1977 58 p refs
(Contract N00173-76-C-0249)
(AD-A050120; AD-E000083; NRL-MR-3657) Avail: NTIS HC A04/MF A01 CSCL 20/11

The scope of this study covers the following two objectives: provide the design for a mechanical-force pulse generator, specify associated hydraulic power unit and controls, and provide pulse-train profiles and mandrels, and perform an exploratory parametric identification study of U.S. Navy medium-weight shock machine, test article, and impact loads using NRL-furnished data.
GRA

N78-21501# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

ON THE DISSIPATION ASSOCIATED WITH EQUILIBRIUM SHOCKS IN FINITE ELASTICITY

James K. Knowles Dec. 1977 53 p refs
(Contract N00014-75-C-0196)
(AD-A050031; TR-38) Avail: NTIS HC A04/MF A01 CSCL 20/11

Equilibrium fields with discontinuous displacement gradients can occur in finite elasticity for certain materials. The presence of such 'equilibrium shocks' affects the energy balance in the elastostatic field, and the present paper is concerned with a notion of dissipation associated with this energy balance. A dissipation inequality is proposed for three-dimensional equilibrium shocks for both compressible and incompressible materials. The consequences of this inequality are studied for weak shocks in plane strain for compressible materials and for shocks of arbitrary strength in anti-plane strain for a class of incompressible materials. A thermodynamic argument for the dissipation inequality is also given. Author (GRA)

N78-21502# Brown Univ., Providence, R. I. Div. of Engineering.

EXPERIMENTS ON VISCOPLASTIC RESPONSE OF CIRCULAR PLATES TO IMPULSIVE LOADING

Sol R. Bodner and Paul S. Symonds Jul. 1977 49 p refs
(Contract N00014-75-C-0860; Grant NSF ENG-74-21258)
(AD-A049866; N00014-0860/6) Avail: NTIS HC A03/MF A01 CSCL 13/13

Tests are described on circular plates of mild steel and commercially pure titanium loaded impulsively by means of explosive sheet. Three loading geometries were used, with magnitudes such that final deflections in the range from one to about seven plate thicknesses were produced. Clamping against radial as well as transverse deflections at the edge was provided. Both materials exhibit strong plastic rate sensitivity. Parameters describing this behavior were obtained from stress-strain tests at low to intermediate rates together with published data for high strain rates. The measured final deflections and response times are compared with predictions of the mode approximation technique as extended to large deflections of viscoplastic structures. Author (GRA)

N78-21503# Florida Univ., Eglin AFB. Graduate Engineering Center.

STUDIES ON THE FAILURE OF METAL MECHANICAL JOINTS SUBJECTED TO DYNAMIC LOADS Final Report, 1 Oct. 1976 - 30 Sep. 1977

C. A. Ross, R. L. Sierakowski, and J. W. Hoover 30 Sep. 1977 47 p refs
(Grant AF-AFOSR-3157-76)
(AD-A050076; AFOSR-78-0078TR) Avail: NTIS HC A03/MF A01 CSCL 11/6

A series of experimental dynamic tests were conducted on riveted joints and struts with central holes to establish quantitatively fracture mechanisms and to determine dynamic load factors based on measured strains. Results of these experimental tests on aluminum struts with a central circular indicate that dynamic stress concentrations associated with the hole are approximately equal to the static stress concentrations for the same specimen. Riveted joints subjected to dynamic loadings exhibit the same general fracture/failure modes associated with similarly static loaded riveted joints. Dynamic response of riveted joints and subsequent fracture are very dependent on the joint stiffness and loading history. Author (GRA)

N78-21504# Washington Univ., Seattle. Dept. of Mechanical Engineering.

DYNAMIC PHOTOELASTIC AND DYNAMIC FINITE ELEMENT ANALYSES OF DYNAMIC TEAR TEST SPECIMENS Interim Technical Report

S. Mall, Albert S. Kobayashi, and Y. Urabe Jan. 1978 29 p refs
(Contract N00014-76-C-0060)
(AD-A049780; TR-31) Avail: NTIS HC A03/MF A01 CSCL 20/11

Dynamic photoelasticity and dynamic finite element methods were used to study the transient response of dynamic tear test (DTT) specimen of a brittle material Homalite-100. The dynamic stress intensity factors obtained from dynamic photoelasticity and dynamic finite element analysis were generally in excellent agreement with each other and showed that the NRL procedure of computing the dynamic fracture initiation toughness from strain gage measurements near the velocity relations was also obtained. Author (GRA)

N78-21505# Argonne National Lab., Ill. Components Technology Div.

DYNAMIC INSTABILITY ANALYSIS OF AXISYMMETRIC SHELLS BY FINITE ELEMENT METHOD WITH CONVECTED COORDINATES

B. J. Hsieh 1977 12 p refs Presented at 4th Intern. Conf. on Structural Mech. in Reactor Technol., San Francisco, 15-19 Aug. 1977
(Contract W-31-109-eng-38)
(CONF-770807-34) Avail: NTIS HC A02/MF A01

The instability of axisymmetric shells has been used in engineering fields as a safety device such as the rupture discs used in the LMFBR (Liquid Metal Fast Breeder Reactor) design to relieve the excessive pressure caused by the water and sodium reaction when there is a leak in the piping system. Hence, the analysis of the instability of shells under time varying loading is becoming more and more important. However, a notorious discrepancy has been observed between various analytical predictions and experiments results for the buckling of shells. Possible causes of this discrepancy have to be studied, among them, the boundary conditions. It has been pointed out that the slip at the boundary may have a noticeable effect on the

transient behavior of a plate. The effect of various boundary conditions on the dynamic instability of axisymmetric shells was studied using the numerical discretization technique-convective finite element method. ERA

42 GEOSCIENCES (GENERAL)

N78-21506# National Oceanic and Atmospheric Administration, Washington, D. C. Center for Experiment Design and Data Analysis.

SUMMARIZATION AND INTERPRETATION OF HISTORICAL PHYSICAL OCEANOGRAPHIC AND METEOROLOGICAL INFORMATION FOR THE MID-ATLANTIC REGION Final Report

Robert G. Williams and Fredric A. Godshall Oct. 1977 307 p Sponsored by Bureau of Land Management, Wash. D. C.
(PB-277104/6; NOAA-78011611) Avail: NTIS HC A14/MF A01 CSCL 13B

The results of an environmental study of the Mid-Atlantic region of the Outer Continental Shelf were described. The main body of oceanographic data consist of salinity, temperature, depth, and Nansen casts, supplemented by ship drift observations, and current meter records. The surface wind field, which plays an important role in determining the movement of spilled oil and other pollutants, was dealt with in detail. The physical characteristics of the water masses in the Mid-Atlantic region, whose structure and variability are particularly relevant to the dispersion and advection of pollutants was discussed and circulation features were analyzed. GRA

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

N78-21507* National Aeronautics and Space Administration, Washington, D. C.

HCMM SATELLITE TO TAKE EARTH'S TEMPERATURE

20 Apr. 1978 42 p
(NASA-News-Release-78-60; P78-10057) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22A

The heat capacity mapping mission (HCMM), a low cost modular spacecraft built for the Applications Explorer Missions (AEM), was designed to allow scientists to determine the feasibility of using day/night thermal infrared remote sensor-derived data to: (1) discriminate various rock types and locate mineral resources; (2) measure and monitor surface soil moisture changes; (3) measure plant canopy temperatures at frequent intervals to determine transpiration of water and plant stress; and (4) measure urban heat islands. The design of the spacecraft (AEM-A), its payload, launch vehicle, orbit, and data collection and processing methods are described. Projects in which the HCMM data will be applied by 12 American and 12 foreign investigators are summarized. A.R.H.

N78-21508 Colorado State Univ., Fort Collins.

ON THE STOCHASTIC MODELING OF DAILY STREAMFLOWS Ph.D. Thesis

Douglas Vargas-Semprun 1977 215 p
Avail: Univ. Microfilms Order No. 7802401

Hydrologic structural analysis, using Markovian models with cyclic components, is reviewed in order to investigate the origin of failure of these models to reproduce the stochastic characteristics of daily streamflow series. Several alternative models are proposed and tested on observed data. A research approach, based on the Monte Carlo method of generating new samples, is implemented to systematically investigate whether the failure of models studied is due to biases in estimation, or to inappropriate models. Results show that underestimation of the number of significant harmonics of periodic parameters completely distorts the further stages of estimation. The estimation procedures used in the hydrologic structural analysis of daily streamflow series are found to be only appropriate for Gaussian processes.
Dissert. Abstr.

N78-21509*# Agricultural Research Service, Weslaco, Tex.

PLANT COVER, SOIL TEMPERATURE, FREEZE, WATER STRESS, AND EVAPOTRANSPIRATION Quarterly Progress Report, 1 Dec. 1977 - 1 Mar. 1978

Craig L. Wiegand, Principal Investigator, Paul R. Nixon, Harold W. Gausman, L. Neal Namken, Ross W. Leamer, and Arthur J. Richardson Apr. 1978 7 p Sponsored by NASA ERTS
(E78-10101; NASA-CR-155963) Avail: NTIS HC A02/MF A01 CSCL 08F

There are no author-identified significant results in this report.

N78-21510*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

STUDY OF SOFT ALKALINE USING LANDSAT IMAGES OF POOLS AND RESIDUE WITH AN EMPHASIS ON RADIOACTIVE MATERIALS [ESTUDO DO MACICO ALCALINO DE POCOS DE CALDAS ATRAVES DE IMAGENS LANDSAT COM ENFASE EM MINERALIZACOES RADIOATIVAS]

Raimundo Almeida Filho, Principal Investigator and Waldir Renato Paradella Sep. 1977 138 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(E78-10104; NASA-CR-156156; INPE-1112-TPT/065) Avail: NTIS HC A08/MF A01 CSCL 05A

There are no author-identified significant results in this report.

N78-21511*# General Electric Co., Philadelphia, Pa. Space Div.

LANDSAT-1 AND LANDSAT-2 FLIGHT EVALUATION REPORT Technical Report, 23 Jul. - 23 Oct. 1977

2 Nov. 1977 224 p refs ERTS
(Contract NAS5-21808)
(E78-10105; NASA-CR-156720; DOC-77sds4258) Avail: NTIS HC A10/MF A01 CSCL 22A

There are no author-identified significant results in this report.

N78-21512*# General Electric Co., Philadelphia, Pa. Space Div.

LANDSAT-C FLIGHT ACTIVATION PLAN

10 Oct. 1977 178 p ERTS
(Contract NAS5-21808)
(E78-10106; NASA-CR-156718; DOC-77SDS4222) Avail: NTIS HC A09/MF A01 CSCL 22A

There are no author-identified significant results in this report.

N78-21513*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

STUDY OF VERTICAL MOVEMENT AND ASSOCIATIVE PRECIPITATION BY EXTRATROPICAL PERTURBATIONS IN SOUTH AMERICA [UM ESTUDO DO MOVIMENTO VERTICAL E PRECIPITACAO ASSOCIADA EM PERTURBACOES EXTRATROPICAIS NA AMERICA DO SUL]

Maria Regina da Silva Aragao, Principal Investigator Jan. 1978 380 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS
(E78-10107; NASA-CR-156124; INPE-1178-TPT/079) Avail: NTIS HC A17/MF A01 CSCL 04B

There are no author-identified significant results in this report.

N78-21514*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

REMOTE SENSING APPLIED TO GEOLOGICAL MAPPING; COMPARATIVE GEOMORPHOLOGY AND IDENTIFICATION OF MINERAL ZONES OF ZINC AND LEAD IN THE REGION

OF VAZANTE, MG [SENSORIAMENTO REMOTO APLICADO A MAPEAMENTO GEOLOGICO, COMPARTIMENTACAO GEOMORFOLOGICA E IDENTIFICACAO DE ZONA MINERALIZADA EM ZINCO E CHUMBO NA REGIAO DE VAZANTE, MG]

Flavio Soares do Nascimento, Principal Investigator and Maria Amelia Leite Soares do Nascimento Nov. 1977 151 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS

(E78-10108; NASA-CR-156125; INPE-1157-TPT/072) Avail: NTIS HC A08/MF A01 CSCL 08G

The author has identified the following significant results. Results showed that the black and white aerial photographs and the color infrared transparencies were efficient for mapping of three lithological units of the Paraopeba formation and for mineralized zones identification, respectively. Multispectral transparencies of I2S made it easier to separate dolomites, which were the rocks conditioning zinc and lead mineralization. Statistical analysis of morphometric indexes obtained from black and white photographs and topographic charts showed significant difference among three lithological units of Paraopeba formation which can be defined as Crest, Hilly, and Karstic reliefs.

N78-21515*# Kansas State Univ., Manhattan. Dept. of Statistics.

APPLICATION OF WHEAT YIELD MODEL TO UNITED STATES AND INDIA Final Report, 1 Mar. - 30 Nov. 1977

Arlin M. Feyerherm, Principal Investigator Dec. 1977 43 p EREP

(Contract NAS9-14533)

(E78-10109; NASA-CR-151656) Avail: NTIS HC A03/MF A01 CSCL 02C

The author has identified the following significant results. The wheat yield model was applied to the major wheat-growing areas of the US and India. In the US Great Plains, estimates from the winter and spring wheat models agreed closely with USDA-SRS values in years with the lowest yields, but underestimated in years with the highest yields. Application to the Eastern Plains and Northwest indicated the importance of cultural factors, as well as meteorological ones in the model. It also demonstrated that the model could be used, in conjunction with USDA-SRRS estimates, to estimate yield losses due to factors not included in the model, particularly diseases and freezes. A fixed crop calendar for India was built from a limited amount of available plot data from that country. Application of the yield model gave measurable evidence that yield variation from state to state was due to different mixes of levels of meteorological and cultural factors.

N78-21516*# South Dakota State Univ., Brookings. Remote Sensing Inst.

HCMM ENERGY BUDGET DATA AS A MODEL INPUT FOR ASSESSING REGIONS OF HIGH POTENTIAL GROUNDWATER POLLUTION Interim Report, Jan. - Mar. 1978

Donald G. Moore, Principal Investigator and J. Heilman Mar. 1978 4 p ERTS

(Contract NAS5-24206)

(E78-10111; NASA-CR-156127) Avail: NTIS HC A02/MF A01 CSCL 08H

There are no author-identified significant results in this report.

N78-21517*# Kansas State Univ., Manhattan. Evapotranspiration Lab.

ESTIMATED WINTER WHEAT YIELD FROM CROP GROWTH PREDICTED BY LANDSAT Final Report, 1 Apr. - 31 Dec. 1977

Edward T. Kanemasu, Principal Investigator 31 Dec. 1977 92 p refs EREP

(Contract NAS9-14899)

(E78-10112; NASA-CR-151655) Avail: NTIS HC A05/MF A01 CSCL 02C

There are no author-identified significant results in this report.

N78-21518*# Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

[HEAT CAPACITY MAPPING MISSION GROUND MEASUREMENTS] Progress Report, 1 Nov. 1977 - 1 Feb. 1978

Ray D. Jackson, Principal Investigator 1 Feb. 1978 4 p ERTS

(NASA Order S-40255B)

(E78-10113; NASA-CR-156128) Avail: NTIS HC A02/MF A01 CSCL 08H

There are no author-identified significant results in this report.

N78-21519*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

FOREST RESOURCE INFORMATION SYSTEM Quarterly Report, 1 Oct. - 31 Dec. 1977

R. P. Mroczynski, Principal Investigator 20 Jan. 1978 33 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. EREP

(Contract NAS9-15325)

(E78-10114; NASA-CR-151653) Avail: NTIS HC A03/MF A01 CSCL 02F

There are no author-identified significant results in this report.

N78-21520*# California Univ., Berkeley. Space Sciences Lab.

AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES Semiannual Progress Report

Robert N. Colwell, Ralph Algazi, Leonard W. Bowden, John E. Estes, Ida R. Hoos, and Siamak Khorram, Principal Investigators 31 Dec. 1977 282 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS

(Grant NGL-05-003-404)

(E78-10115; NASA-CR-156080; SSL-Ser-19-Issue-17) Avail: NTIS HC A13/MF A01 CSCL 08F

There are no author-identified significant results in this report.

N78-21521*# Environmental Research and Technology, Inc., Concord, Mass.

INVESTIGATION OF THE APPLICATION OF HCMM THERMAL DATA TO SNOW HYDROLOGY Progress Report, Jan. - Mar. 1978

James C. Barnes, Principal Investigator 12 Apr. 1978 5 p Sponsored by NASA ERTS

(E78-10116; NASA-CR-156081) Avail: NTIS HC A02/MF A01 CSCL 08H

There are no author-identified significant results in this report.

N78-21522*# Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

INVENTORY OF FOREST RESOURCES (INCLUDING WATER) BY MULTI-LEVEL SAMPLING Final Report, 7 Mar. 1975 - 15 Jul. 1977

Robert C. Aldrich, Robert W. Dana, and Edwin H. Roberts, Principal Investigators 15 Jul. 1977 183 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS

(NASA Order S-54053A)

(E78-10118; NASA-CR-156083) Avail: NTIS HC A09/MF A01 CSCL 02F

The author has identified the following significant results. A stratified random sample using LANDSAT band 5 and 7 panchromatic prints resulted in estimates of water in counties with sampling errors less than + or - 9% (67% probability level). A forest inventory using a four band LANDSAT color composite resulted in estimates of forest area by counties that were within + or - 6.7% and + or - 3.7% respectively (67% probability level). Estimates of forest area for counties by computer assisted techniques were within + or - 21% of operational forest survey figures and for all counties the difference was only one percent. Correlations of airborne terrain reflectance measurements with LANDSAT radiance verified a linear atmospheric model with an

additive (path radiance) term and multiplicative (transmittance) term. Coefficients of determination for 28 of the 32 modeling attempts, not adverseley affected by rain shower occurring between the times of LANDSAT passage and aircraft overflights, exceeded 0.83.

N78-21523*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GEOLOGIC APPLICATION OF THERMAL INERTIA IMAGING USING HCMM DATA Quarterly Report, Jan. - Mar. 1978
Anne B. Kahle, Principal Investigator and Helen N. Paley Apr. 1978 4 p ERTS
(Contract NAS7-100)
(E78-10119; NASA-CR-156086) Avail: NTIS HC A02/MF A01 CSCL 08G

There are no author-identified significant results in this report.

N78-21524*# Environmental Research Inst. of Michigan, Ann Arbor.
USE OF LANDSAT DATA TO ASSESS WATERFOWL HABITAT QUALITY Final Report, Apr. 1975 - Jan. - 1978
John E. Colwell, David S. Gilmer, Principal Investigators (Northern Prairie Wildlife Research Center, Jamestown, N. Dak.), Edgar A. Work, Jr., Diana L. Rebel, and Norman E. G. Roller Jan. 1978 92 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. ERTS
(NASA Order S-54049A; Contract DI-14-16-008-2018)
(E78-10120; NASA-CR-156087; ERIM-120000-15-F) Avail: NTIS HC A05/MF A01 CSCL 06C

The author has identified the following significant results. The capability of mapping ponds over a very large area was demonstrated, with multidate, multiframe LANDSAT imagery. A small double sample of aircraft data made it possible to adjust a LANDSAT large area census. Terrain classification was improved by using multitemporal LANDSAT data. Waterfowl production was estimated, using remotely determined pond data, in conjunction with FWS estimates of breeding population. Relative waterfowl habitat quality was characterized on a section by section basis.

N78-21525*# Fairchild Imaging Systems, Syosset, N. Y.
ENGINEERING STUDY FOR PALLET ADAPTING THE APOLLO LASER ALTIMETER AND PHOTOGRAPHIC CAMERA SYSTEM FOR THE LIDAR TEST EXPERIMENT ON ORBITAL FLIGHT TESTS 2 AND 4 Final Report
Edward J. Kuebert 12 Aug. 1977 70 p ref
(Contract NAS5-24112)
(NASA-CR-152615; ED-JF-5) Avail: NTIS HC A04/MF A01 CSCL 14E

A Laser Altimeter and Mapping Camera System was included in the Apollo Lunar Orbital Experiment Missions. The backup system, never used in the Apollo Program, is available for use in the Lidar Test Experiments on the STS Orbital Flight Tests 2 and 4. Studies were performed to assess the problem associated with installation and operation of the Mapping Camera System in the STS. They were conducted on the photographic capabilities of the Mapping Camera System, its mechanical and electrical interface with the STS, documentation, operation and survivability in the expected environments, ground support equipment, test and field support. Author

N78-21526*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPLICATION OF REMOTE SENSING TO THE CHESAPEAKE BAY REGION. VOLUME 2: PROCEEDINGS
W. T. Chen, ed., G. W. Freas, Jr., ed., G. D. Hickman, ed. (Maryland Univ., College Park), D. A. Pemberton, ed. (Maryland Univ., College Park), T. D. Wilkerson, ed. (Maryland Univ., College Park), I. Adler, ed. (Maryland Univ., College Park), and V. J. Laurie, ed. (EPA, Washington, D.C.) Feb. 1978 388 p refs Conf. held at Berkeley Springs, W. Va., 12-15 Apr. 1977; sponsored by NASA, EPA, and Maryland Univ., College Park
(NASA-CP-6; G-7719) Avail: NTIS HC A17/MF A01 CSCL 08J

A conference was held on the application of remote sensing to the Chesapeake Bay region. Copies of the papers, resource contributions, panel discussions, and reports of the working groups are presented. For individual titles, see N78-21527 through N78-21561.

N78-21527*# United States Senate, Washington, D. C.
THE CHESAPEAKE BAY: OUR REGIONAL RESOURCE
Charles McC. Mathias, Jr. *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 5-10 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08J

The contents are presented of a speech given by the Hon. Charles McC. Mathias, Jr. on the value of the Chesapeake Bay as a resource and the need to protect its environmental quality. L.S.

N78-21528*# Environmental Protection Agency, Philadelphia, Pa.
THE CHESAPEAKE BAY PROGRAM: AN OPPORTUNITY TO USE AN INNOVATIVE MONITORING TECHNIQUE
Leonard Mangiaracina *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 11-15 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 05A

The goal of this program is to develop a management system that will protect and preserve the water quality of the Chesapeake Bay by effectively managing its uses and resources. To achieve this goal, three major objectives must be accomplished: (1) Determine what units of government have management responsibility for the environmental quality of the Chesapeake Bay, also to define how such management responsibility can best be structured so that communications and coordination can be improved between the respective units of government, research, educational institutions, concerned groups, and individuals. (2) Assess the principal factors having an adverse impact on the environmental quality of the Chesapeake Bay. Following this assessment and review of ongoing research, direct and coordinate research and abatement programs that will most effectively address these factors, and (3) analyze all environmental sampling data now being collected on the Chesapeake Bay and suggest and undertake methods for improving this data collection, and to establish a continuing capability for collecting storing, analyzing, and disseminating these data. Author

N78-21529*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRESENT STATUS OF LANDSAT REMOTE SENSING
Phillip J. Cressy *In its* Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 21-23 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08J

The state-of-the-practice of satellite remote sensing is examined. Emphasis is placed on the use of remote sensing to improve information gathering practices. Impediments to adopting this technology and opportunities to overcome these impediments are addressed. Author

N78-21530*# Geological Survey, Reston, Va.
ACTIVITIES OF THE US GEOLOGICAL SURVEY IN APPLICATIONS OF REMOTE SENSING IN THE CHESAPEAKE BAY REGION
James R. Wray *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 25-26 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08J

The application of remote sensing in the Chesapeake Bay region has been a central concern of three project activities of the U.S. Geological Survey: two are developmental, and one is operational. The two developmental activities were experiments in land-use and land-cover inventory and change detection using remotely sensed data from aircraft and from the LANDSAT and Skylab satellites. One of these is CARETS (Central Atlantic Regional Ecological Test Site). The other developmental task is the Census Cities Experiment in Urban Change Detection. The present major concern is an operational land-use and land-cover data-analysis program, including a supporting geographical information system. Author

N78-21531*# Forest Service, Washington, D. C.
OPERATIONAL PROGRAMS IN FOREST MANAGEMENT

AND PRIORITY IN THE UTILIZATION OF REMOTE SENSING
Robert W. Douglass *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 27-31 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 02F

A speech is given on operational remote sensing programs in forest management and the importance of remote sensing in forestry is emphasized. Forest service priorities in using remote sensing are outlined. L.S.

N78-21532*# Regional Planning Council, Baltimore, Md.
LANDSAT AND OTHER SENSOR DATA FOR LAND-USE PLANNING IN THE BALTIMORE AREA
James Manley *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 33-35 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 05A

Investigations of the current uses of the LANDSAT sensor data revealed that there were no successful uses of LANDSAT data in identifying specific urban uses other than densities of residential use, paved areas, and roof tops. Information was merged on developed land uses from the air photointerpretation and the land cover from the LANDSAT sensors. It was expected that this would give the most accurate results by taking results from each technique when they were best. Author

N78-21533*# Maryland Geological Survey, Baltimore.
REMOTE SENSING, GEOLOGY, AND LAND USE
Kenneth N. Weaver *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 37-43 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08G

The usefulness of a geologic map as a product in geological research was discussed, and the volution of the geologic map of Maryland was illustrated. Remote sensing methods that have the most immediate application to the earth science aspects of the Chesapeake Bay region are listed. B.B.

N78-21534*# Maryland Dept. of State Planning, Baltimore.
MARYLAND AUTOMATED GEOGRAPHIC INFORMATION SYSTEM
Edwin L. Thomas *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 45-47 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 05B

A computer based system designed for storing geographic data in a consistent and coordinated manner is described. The data are stored, retrieved, and analyzed using a 400 km sq/acre cell. Stored information can be displayed on computer maps in a manner similar to standard map graphics. The data bank contains various information for performing land use analysis in a variety of areas. Author

N78-21535*# Environmental Protection Agency, Washington, D. C.
THE CHESAPEAKE BAY: A CHALLENGE TO THE REMOTE SENSING COMMUNITY
C. Eugene James *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 49-54 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08J

The use of remote sensing in studying, monitoring, and understanding the Chesapeake Bay was examined. References to multispectral scanning, laser techniques, infrared microwave, and radar were made. These aspects were then analyzed with multidimensional models, digital analysis, and holographic projections. Author

N78-21536*# Maryland Univ., College Park.
MISSION OF A REMOTE SENSING CENTER
Robert M. Ragan, Dixie A. Pemberton, and Thomas D. Wilkerson *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 55-57 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 05B

The establishment of a center for remote sensing was proposed to provide the following: (1) service, research, and education in the developing discipline of remote sensing; (2) effect multidisciplinary linkages between scientists and users of remote sensing and those who develop remote sensing techniques; and (3) strengthen and extend existing remote sensing capabilities into a cohesive program. Author

N78-21537*# Maryland Univ., Cambridge. Center for Environmental and Estuarine Studies.
ON MEASURING THE STATE OF THE BAY
Peter E. Wagner *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 87-101 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08J

The requirements necessary to establish a comprehensive data base for the Chesapeake Bay are discussed. Three essential questions were addressed: (1) which entities should be measured; (2) how close together should measurements be made in space and time; and (3) what should be done with the data. Possible answers to the questions were evaluated in relation to existing technology, cost effectiveness, and potential uses of the data base. P.R.A.

N78-21538*# Maryland Univ., Frostburg. Center for Environmental and Estuarine Studies.
USE OF REMOTE SENSING TECHNOLOGY PROVIDED BY THE NASA/WFC CHESAPEAKE BAY ECOLOGICAL PROGRAM
Dan M. Harman, Kent B. Fuller, and Dale B. Fuller *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 103-109 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 13B

Use of remote sensing technology provided through the NASA/Wallops Chesapeake Bay Ecological Program was investigated by means of extensive interviews with users. Since the inception of the Program four years ago, the technology has been used in 136 different managerial projects. Sixty-five regional managerial agencies took part in projects that the authors categorized as socioeconomic, political/managerial, monetary, legal, and other. Remote sensing technology was considered successful in 88.6 percent of the completed projects and unsuccessful in 2.8 percent. Author

N78-21539*# Corps of Engineers, Baltimore, Md.
HYDRAULIC MODEL OF THE CHESAPEAKE BAY
Alfred E. Robinson, Jr. *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 111-121 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08C

Preliminary planning for the formulation of the first year of hydraulic studies on the Chesapeake Bay model was recently completed. The primary purpose of this initial effort was to develop a study program that is both responsive to problems of immediate importance and at the same time ensure that from the very beginning of operation maximum economical use is made of the model. The formulation of this preliminary study plan involved an extensive analysis of the environmental, economic, and social aspects of a series of current problems in order to establish a priority listing of their importance. The study program that evolved is oriented towards the analysis of the effects of some of the works of man on the Chesapeake Bay estuarine environment. Author

N78-21540*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT SENSORS
Stanley C. Freden and Robert D. Price *In its* Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 123-140 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 14B

LANDSAT 1, launched in July 1972, and LANDSAT 2, launched in January 1975, are equipped with a similar complement of sensors. Each spacecraft has both a return beam vidicon camera system and a multispectral scanner for acquiring high resolution multispectral data of the Earth's surface on a global basis. A description is given of these imaging systems and the primary sensors on the LANDSAT 1 and 2 spacecraft. Author

N78-21541*# National Environmental Satellite Service, Washington, D. C.

REMOTE SENSING OF WATER QUALITY

Warren A. Hovis *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 141-148 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08H

Remote sensing from aircraft has been used to determine water content in areas such as the New York Bight. Extension of the techniques developed to satellite sensing of the Chesapeake Bay will begin in 1978 with the launch of Nimbus-G. Remote sensing offers a number of interesting possibilities for investigating a reasonably large body of water, such as the Chesapeake Bay, coupled with some disadvantages. The chief advantage of remote sensing is that it offers the opportunity to cover large areas in relatively short periods of time. Low altitude satellites traveling at about 7 km/s can cover the Chesapeake Bay in about 1 minute so that the entire Bay can be studied under almost identical conditions of solar illumination. Author

N78-21542*# National Oceanic and Atmospheric Administration, Rockville, Md. Engineering Development Lab.

ACOUSTIC REMOTE PROBING OF THE ENVIRONMENT

John A. Pijanowski *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 149-156 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 20A

Atmospheric acoustic probes located either at shore locations near the Chesapeake Bay or on large surface buoys could obtain profiles of wind velocity and turbulence and the temperature and humidity of the atmosphere. At or near the buoy locations, underwater probes located on the bottom could be used to profile current velocity, density, and turbulence and also to determine tide level, wave height, spectrum, and direction. The physical parameter profiles at these earth-surface stations could be used with surface observations by satellite. The most obvious use of data from such a network is to verify and calibrate models of energy exchange between the water of the Bay and the atmosphere. Author

N78-21543*# Maryland Univ., Prince Frederick. Chesapeake Biological Lab.

REGIONAL ENERGETIC COUPLING OF MAN AND HIS ENVIRONMENT: DATA REQUIREMENTS

J. A. Mihursky, W. R. Boynton, W. M. Kemp, M. L. Homer, and G. E. Unger (Michigan Univ., Ann Arbor) *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 157-175 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 13B

An energy analysis methodology was developed to serve as a rational basis for evaluating alternative regional management/use schemes. Human and natural systems are coupled and can be interpreted, using a common base of energy-flow analysis to evaluate past, present, and future states of regional integrated systems in the coastal zone and to provide the capability for rational selection of alternative patterns of resource use. Energy flows (or flows of dollars or materials converted to energy equivalents) are believed to be the basic factor in the organizations of all types of systems. An analysis example is provided of an estuarine subsystem of the Chesapeake Bay, and tabular listings of regional data needs are given. Current remote sensing capabilities were used to provide some of the necessary information. Author

N78-21544*# Smithsonian Institution, Edgewater, Md. Chesapeake Bay Center for Environmental Studies.

RELATIONSHIP OF LAND USE TO WATER QUALITY IN THE CHESAPEAKE BAY REGION

David L. Correll *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 177-187 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08H

Both the proportions of the various land use categories present on each watershed and the specific management practices in use in each category affect the quality of runoff waters, and the water quality of the Bay. Several permanent and portable stations on various Maryland Rivers collect volume-integrated water samples. All samples are analyzed for a series of nutrient, particulate, bacterial, herbicide, and heavy metal parameters. Each basin is mapped with respect to land use by the analysis of low-elevation aerial photos. Analyses are verified and adjusted by ground truth surveys. Data are processed and stored in the Smithsonian Institution data bank. Land use categories being investigated include forests/old fields, pastureland, row crops, residential areas, upland swamps, and tidal marshes. Author

N78-21545*# Corps of Engineers, Baltimore, Md.

AN OVERVIEW OF DREDGING OPERATIONS IN THE CHESAPEAKE BAY

Ronald H. Silver *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 209-215 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 13B

Maintenance of the Baltimore and the Newport News/Norfolk harbors as well as of the Chesapeake and Delaware Canal is accomplished by different dredging operations which depend on the amount and type of material to be moved, water depth, and location of disposal sites. Methods for determining the physical or chemical-biological interactive effects of these activities on the environment and on the shellfish and finfish industries on the Bay are discussed. The types of dredges used are classed according to their mode of operation. Author

N78-21546*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

REMOTE IN-SITU ELEMENTAL ANALYSIS SYSTEMS FOR UNDERWATER APPLICATION

Jacob I. Trombka and Kurt R. Stehling (NOAA, Rockville, Md.) *In its* Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 217-221 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 05B

The systems approach, theoretical measurement calculations, and preliminary measurements to be used in monitoring and mapping pollutants (such as traces of heavy metals) in the Chesapeake Bay are discussed. A neutron gamma-ray method is under development for demonstrating the system. The excitation source to be used is a machine accelerator using a deuterium/tritium reaction to produce 14-MeV neutrons. The neutrons excite characteristic gamma ray emission from the neutron irradiated surface. The discrete line emission produced can be used to infer both qualitative and quantitative elemental composition. A data preprocessor will accumulate, digitize, store, format, and prepare the data for transmission which can be accomplished by telephone, microwave, and possibly satellite link to central processors. Author

N78-21547*# Power Plant Siting Program, Annapolis, Md.

THERMAL DISCHARGES AND THEIR ROLE IN PENDING POWER PLANT REGULATORY DECISIONS

Myron H. Miller *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 223-237 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 13B

Federal and state laws require the imminent retrofit of offstream condenser cooling to the newer steam electric stations. Waiver can be granted based on sound experimental data, demonstrating that existing once-through cooling will not adversely affect aquatic ecosystems. Conventional methods for monitoring thermal plumes, and some remote sensing alternatives, are reviewed, using on going work at one Maryland power plant for illustration. Author

N78-21548*# Environmental Measurements, Inc., Annapolis, Md.

WORK ON POWER-PLANT (AIR) PLUMES INVOLVING REMOTE SENSING OF SO2

Charles L. White, Jr. *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 239-247 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 13B

Acquisition of air quality and concurrent meteorological data was used for dispersion model development and plant siting needs of the Maryland power plants. One of the major instruments in these studies was the Barringer correlation spectrometer, a remote sensor, using atmospherically scattered sunlight that was

used to measure the total amount of SO2 in a cross section of the plume. Correlation spectrometer and its role in this measurement program are described. Author

N78-21549*# Maryland Univ., College Park.
LIDAR: A LASER TECHNIQUE FOR REMOTE SENSING
Thomas D. Wilkerson and G. Daniel Hickman (Appl. Sci. Tech., Inc., Germantown, Md.) *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 249-265 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 20E

Experimental airborne lidar systems proved to be useful for shallow water bathymetric measurements, and detection and identification of oil slicks and algae. Dye fluorescence applications using organic dyes was studied. The possibility of remotely inducing dye flourescence by means of pulsed lasers opens up several hydrospheric applications for measuring water currents, water temperature, and salinity. Aerosol measurements by lidar are also discussed. J.A.M.

N78-21550*# Maryland Dept. of Health and Mental Hygiene, Baltimore.
WATER QUALITY AND SHELLFISH SANITATION
Max Eisenberg *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 267-268 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08A

The use of remote sensing techniques for collecting bacteriological, physical, and chemical water quality data, locating point and nonpoint sources of pollution, and developing hydrological data was found to be valuable to the Maryland program if it could be produced effectively and rapidly with a minimum amount of ground corroboration. Author

N78-21551*# Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
EUTROPHICATION IN THE CHESAPEAKE BAY
Robert E. Ulanowicz *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 269-273 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08A

The advantages and limitations of using remote sensing to acquire fast reliable data on the nutrient problem in the Chesapeake Bay ecosystem are discussed. Pollution effects to phytoplankton blooms during late summer and early fall months are also considered. J.A.M.

N78-21552*# American Univ., Washington, D. C. Dept. of Biology.
INFERRING NUTRIENT LOADING OF ESTUARINE SYSTEMS BY REMOTE SENSING OF AQUATIC VEGETATION
Richard R. Anderson *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 275-281 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08A

THe use of remote sensing to record algal and vascular aquatic plant growths in estuarine waters is discussed. A technique is proposed that uses a combination of data to hierarchically classify watersheds with regard to severity of potential pollution. Specific nonpoint sources of nutrients in tributaries of the watershed are identified with lower altitude photography of vegetation and selected ground sampling. It is concluded that excessive growths of some aquatic plants may be related to nutrient pollution. Author

N78-21553*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CONTRIBUTION OF REMOTE SENSING TO UNDERSTAND THE BAY AS A SYSTEM
Archibald B. Park, Daniel Anderson, Charles G. Bohn, Wayne T. Chen, and Robert W. Johnson *In its* Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 289-296 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08J

The natural resource management information system concept designed specifically for use with remote sensing is discussed in terms of understanding and studying the Chesapeake Bay as a total system. The Bay is defined as a system comprising the lithosphere, the hydrosphere, and the biosphere, that is the vertical profile encompassed by the systems and a two dimensional plane defining the total watershed of the Bay from the headwaters of its tributaries to a distance in the ocean defined by ten tidal cycles. The Chesapeake Bay system is assumed to be the ecosystem in the largest sense. Ecological partitioning, a methodology resulting from studies of land systems for partitioning the land into geobotanical landscape units, is included along with a breakdown of LANDSAT investigations according to subject area. J.M.S.

N78-21554*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROLE OF REMOTE SENSING IN DOCUMENTING LIVING RESOURCES
Peter E. Wagner, Richard R. Anderson, Bert Brun, Max Eisenberg, John B. Genys, Donald W. Lear, Jr., and Myron H. Miller *In its* Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 297-301 refs (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08A

Specific cases of known or potentially useful applications of remote sensing in assessing biological resources are discussed. It is concluded that the more usable remote sensing techniques relate to the measurement of population fluctuations in aquatic systems. Sensing of the flora and the fauna of the Bay is considered with emphasis on direct sensing of aquatic plant populations and of water quality. Recommendations for remote sensing projects are given. J.M.S.

N78-21555*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USE OF REMOTE SENSING IN FACILITY SITING
Milton L. Moon, Robert F. Hunt, John McFall, Jr., John A. Pijanowski, and Robert D. Price *In its* Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 303-309 ref (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 13B

Environmental parameters important to, and necessary for, an environment impact assessment in terms of site selection for an electric power plant are defined. Remote sensing techniques and/or instrumentation applicable to site evaluation are described. Problem areas are discussed and recommendations given. J.M.S.

N78-21556*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROLE OF REMOTE SENSING IN DOCUMENTING LAND USE AS IT AFFECTS THE BAY AND BAY USE AS IT AFFECTS THE LAND
William F. Rhodes, John M. Garber, John M. Hill, and Walter E. Raum *In its* Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 311-313 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 08B

The remote sensing technology required for locating, identifying, and monitoring nonpoint, or diffuse, pollution caused by improper land use practices is discussed. Establishment of an information system to include all remote sensed data acquired on the Bay and to disseminate information to users is considered. J.M.S.

N78-21557*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ROLE OF REMOTE SENSING IN BAY MEASUREMENTS
John P. Mugler, Jr., John P. Godfrey, G. Daniel Hickman, Warren G. Hovis, Albin O. Pearson, and Kenneth N. Weaver *In its* Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 315-321 (For availability see N78-21526 12-43)
Avail: NTIS HC A17/MF A01 CSCL 14B

Remote measurements of a number of surface or near surface parameters for baseline definition and specialized studies, remote measurements of episodic events, and remote measurements of the Bay lithosphere are considered in terms of characterizing and understanding the ecology of the Chesapeake Bay. Geologic processes and features best suited for information enhancement by remote sensing methods are identified. These include: (1) rates of sedimentation in the Bay; (2) rates of erosion of Bay shorelines; (3) spatial distribution and geometry of aquifers; (4) mapping of Karst terrain (sinkholes); and (5) mapping of

fracture patterns. Recommendations for studying problem areas identified are given. J.M.S.

N78-21558*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

POSSIBLE ROLE OF REMOTE SENSING FOR INCREASING PUBLIC AWARENESS OF THE CHESAPEAKE BAY ENVIRONMENT

Thomas D. Wilkerson, Patricia A. Maher, Gloria Billings, Philip J. Cressy, John W. Jarman, Norman H. MacLeod, Jacob I. Trombka, and Tom Wisner *In its* Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 323-326 refs (For availability see N78-21526 12-43)

Avail: NTIS HC A17/MF A01 CSCL 05B

Application of remote sensing techniques to the study of the Chesapeake Bay and the availability of the resulting information are discussed in terms of public awareness of the Chesapeake Bay, its total environment, and the need to protect that environment and to preserve the Bay. Recommendations given include: (1) continue the study of remote sensing technology and its use in the Chesapeake Bay region; (2) emphasize the importance of LANDSAT imagery to the evolution of remote sensing technological developments and the awareness of the environment and its changes; (3) increase dissemination of information of the environmental applications of remote sensing technology to the public; (4) design surveys of the Chesapeake Bay environment and its manmade changes; and (5) establish a coordinating regional institution to develop a management plan for the Chesapeake Bay. J.M.S.

N78-21559*# National Conference of State Legislatures, Denver, Colo.

NCSL TASK FORCE FINDINGS ON FEASIBLE STATE USES OF LANDSAT

Sally M. Bay *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 333-344 refs (For availability see N78-21526 12-43)

Avail: NTIS HC A17/MF A01 CSCL 05A

Data needs for state natural resources programs, state capabilities for using satellite technology, and the existing remote sensing technology are reviewed. State programs in land use planning, wetlands management, coastal zone management, transportation planning, and forestry management are summarized. Emphasis is placed on the use of LANDSAT imagery. J.M.S.

N78-21560*# Virginia Inst. of Marine Science, Gloucester Point. Remote Sensing Section.

PROGRESS TOWARD A CIRCULATION ATLAS FOR APPLICATION TO COASTAL WATER SITING PROBLEMS

John C. Munday, Jr. and Hayden H. Gordon *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 345-358 refs (For availability see N78-21526 12-43)

(Grant NGL-47-022-005)

(VIMS-Contrib-823) Avail: NTIS HC A17/MF A01 CSCL 08B

Circulation data needed to resolve coastal siting problems are assembled from historical hydrographic and remote sensing studies in the form of a Circulation Atlas. Empirical data are used instead of numerical model simulations to achieve fine resolution and include fronts and convergence zones. Eulerian and Langrangian data are collected, transformed, and combined into trajectory maps and current vector maps as a function of tidal phase and wind vector. Initial Atlas development is centered on the Elizabeth River, Hampton Roads, Virgina. Author

N78-21561*# Maryland-National Capital Park and Planning Commission, Silver Spring, Md.

APPLICATION OF A COMPUTERIZED ENVIRONMENTAL INFORMATION SYSTEM TO MASTER AND SECTOR PLANNING

John C. Stewart *In* NASA. Goddard Space Flight Center Appl. of Remote Sensing to the Chesapeake Bay Reg. Feb. 1978 p 359-371 refs (For availability see N78-21526 12-43)

Avail: NTIS HC A17/MF A01 CSCL 05B

A computerized composite mapping system developed as an aid in the land use decision making process is described. Emphasis is placed on consideration of the environment in urban planning. The presence of alluvium, shallow bedrock, surface water, and vegetation growth are among the environmental factors considered. An analysis of the Shady Grove Sector planning is presented as an example of the use of computerized composite mapping for long range planning. J.M.S.

N78-21562*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

ACTIVE MICROWAVE USERS WORKSHOP REPORT

Richard E. Matthews, ed. 1978 300 p refs Conf. held at Houston, Tex., Aug. 1976

(NASA-CP-2030; S-476) Avail: NTIS HC A13/MF A01 CSCL 14B

The following topics were addressed: (1) Seasat land experiments; (2) program planning; (3) Synthetic Aperture Radar (SAR) data processing and (4) applications. For individual titles, see N78-21563 through N78-21567.

N78-21563*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SUMMARY OF THE ACTIVE MICROWAVE USERS WORKSHOP

In its Active Microwave Users Workshop Rept. 1978 p 1-14 (For availability see N78-21562 12-43)

Avail: NTIS HC A13/MF A01 CSCL 14B

A coordinated microwave applications development program was initiated to improve the capability to: (1) identify, monitor, and assess the earth's resources; and (2) monitor the earth's environment and predict significant changes. The program consists of the scientific, technical, and programmatic activities required to develop microwave remote sensing into an operational tool for systematic earth observations. Author

N78-21564*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

APPLICATIONS OF ACTIVE MICROWAVE IMAGERY

F. P. Weber, Leo F. Childs, Richard Gilbert, J. C. Harlan, Roger Hoffer, John M. Miller, John Parsons, Fabian Polcyn, B. B. Schardt, James L. Smith et al *In its* Active Microwave Users Workshop Rept. 1978 p 15-48 refs (For availability see N78-21562 12-43)

Avail: NTIS HC A13/MF A01 CSCL 14B

The following topics were discussed in reference to active microwave applications: (1) Use of imaging radar to improve the data collection/analysis process; (2) Data collection tasks for radar that other systems will not perform; (3) Data reduction concepts; and (4) System and vehicle parameters: aircraft and spacecraft. Author

N78-21565*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SEASAT LAND EXPERIMENTS

John E. Estes, Frank Barath, Nevin Bryant, P. J. Cannon, Charles Elachi, Alex Goetz, Kumar Krishen, Harold C. MacDonald, Allen Marmelstein, Leo J. Miller et al *In its* Active Microwave Users Workshop Rept. 1978 p 49-122 refs (For availability see N78-21562 12-43)

Avail: NTIS HC A13/MF A01 CSCL 05B

An overview of the Seasat land experiments is presented. The potential roles for active microwave imaging systems on board satellites were reviewed with particular emphasis on the Seasat Synthetic Aperture Radar (SAR). Recommendations were made concerning the type of experiments that could most profitablly be conducted over land with the Seasat SAR system capabilities available. Author

N78-21566*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

ACTIVE MICROWAVE USERS WORKING GROUP PROGRAM PLANNING

Fawwaz T. Ulaby, Janet Bare, W. E. Brown, Jr., Leo F. Childs, Louis F. Dellwig, John E. Heighway, Rigdon Joosten, Anthony J. Lewis, William Linlor, Jerry R. Lundien et al *In its* Active Microwave Users Workshop Rept. 1978 p 123-196 refs (For availability see N78-21562 12-43)

Avail: NTIS HC A13/MF A01 CSCL 05A

A detailed programmatic and technical development plan for active microwave technology was examined in each of four

user activities: (1) vegetation; (2) water resources and geologic applications, and (4) oceanographic applications. Major application areas were identified, and the impact of each application area in terms of social and economic gains were evaluated. The present state of knowledge of the applicability of active microwave remote sensing to each application area was summarized and its role relative to other remote sensing devices was examined. The analysis and data acquisition techniques needed to resolve the effects of interference factors were reviewed to establish an operational capability in each application area. Flow charts of accomplished and required activities in each application area that lead to operational capability were structured. Author

N78-21567*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SYNTHETIC APERTURE RADAR (SAR) DATA PROCESSING

Frederick L. Beckner, Homer A. Ahr, Dale A. Ausherman, Lewis J. Cutrona, Sherman Francisco, Robert E. Harrison, Janeth S. Heuser, Rolando L. Jordan, Jim Justus, Bob Manning et al *In its* Active Microwave Users Workshop Rept. 1978 p 197-277 refs (For availability see N78-21562 12-43)

Avail: NTIS HC A13/MF A01 CSCL 05B

The available and optimal methods for generating SAR imagery for NASA applications were identified. The SAR image quality and data processing requirements associated with these applications were studied. Mathematical operations and algorithms required to process sensor data into SAR imagery were defined. The architecture of SAR image formation processors was discussed, and technology necessary to implement the SAR data processors used in both general purpose and dedicated imaging systems was addressed. Author

N78-21568*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE USE OF LANDSAT DIGITAL DATA AND COMPUTER-IMPLEMENTED TECHNIQUES FOR AN AGRICULTURAL APPLICATION

Armond T. Joyce (NASA. Earth Resources Lab., Slidell, La.) and R. H. Griffin, II (NASA. Earth Resources Lab., Slidell, La.) Jan. 1978 48 p refs Original contains color illustrations

(NASA-RP-1016; JSC-12897; S-477) Avail: NTIS HC A03/MF A01 CSCL 02C

Agricultural applications procedures are described for use of LANDSAT digital data and other digitalized data (e.g., soils). The results of having followed these procedures are shown in production estimates for cotton and soybeans in Washington County, Mississippi. Examples of output products in both line printer and map formats are included, and a product adequacy assessment is made. Author

N78-21569*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EVALUATION OF LANDSAT MSS VS TM SIMULATED DATA FOR DISTINGUISHING HYDROTHERMAL ALTERATION

Michael J. Abrams, Anne B. Kahle, Daryl P. Madura, and James M. Soha 1 Mar. 1978 55 p refs

(Contract NAS7-100)

(NASA-CR-156168; JPL-Pub-77-83) Avail: NTIS HC A04/MF A01 CSCL 05B

The LANDSAT Follow-On (LFO) data was simulated to demonstrate the mineral exploration capability of this system for segregating different types of hydrothermal alteration and to compare this capability with that of the existing LANDSAT system. Multispectral data were acquired for several test sites with the Bendix 24-channel MSDS scanner. Contrast enhancements, band ratioing, and principal component transformations were used to process the simulated LFO data for analysis. For Red Mountain, Arizona, the LFO data allowed identification of silicified areas, not identifiable with LANDSAT 1 and 2 data. The improved LFO resolution allowed detection of small silicic outcrops and of a narrow silicified dike. For Cuprite - Ralston, Nevada, the LFO spectral bands allowed discrimination of argillic and opalized altered areas; these could not be spectrally discriminated using LANDSAT 1 and 2 data. Addition of data from the 1.3- and 2.2- micrometer regions allowed better discriminations of hydrothermal alteration types. Author

N78-21570*# National Aeronautics and Space Administration, Washington, D. C.

LANCHAD: REMOTE SENSING OF THE N'DJAMENA AREA AND THE LOGONE-CHARI CONFLUENT

C. Bardinet and J. M. Monget Apr. 1978 150 p refs Transl. into ENGLISH of "Teledetection de la Zone de N'Djamena et du Confluent Logone-Chari", Rept. Paris Univ., Ecole Normale Superieure, Ecole Nationale Superieure des Mines de Paris, and Universite du Tchad, N'Djamena, Chad-Paris, Oct. 1977 p 1-114 Transl. by SCITRAN, Santa Barbara, Calif.

(NASA-TM-75087) Avail: NTIS HC A07/MF A01 CSCL 05B

The Republic of Chad's experimental beginnings of a program of earth resources inventory utilizing remote sensing from satellites. The program contemplates utilization of data from LANDSAT 1 and 2, NOAA, METEOSAT, and SPOT. Author

N78-21571*# National Aeronautics and Space Administration, Washington, D. C.

METRIC REMOTE SENSING EXPERIMENTS IN PREPARATION FOR SPACELAB FLIGHTS

G. Galibert 1978 29 p Transl. into ENGLISH from Experiences de teledetection metrique dans les alpes en vue des vols spacelab, Revue de geographie Alpine, France, vol. 66, no. 1, 1978, p 43-63

(NASA-TM-75093) Avail: NTIS HC A03/MF A01 CSCL 14E

Aerial and ground photographs of Wallis mountains and of Dolomiti di Cortina d'Ampezzo in Italy were made using spectrozonal emulsions and optical multichannel filters. A metric camera was used in the perspective of the first Spacelab flight aboard the space shuttle. Elementary forms of alpine geomorphology and ice or snow phenomena are detectable on these metric scenes. Author

N78-21572*# Aerojet Electrosystems Co., Azusa, Calif.

SNOW PARAMETERS FROM NIMBUS-6 ELECTRICALLY SCANNED MICROWAVE RADIOMETER Final Report

G. Abrams and A. T. Edgerton Sep. 1977 195 p refs

(Contract NAS5-23751)

(NASA-CR-156725; Rept-1932FR-1) Avail: NTIS HC A09/MF A01 CSCL 08L

Two sites in Canada were selected for detailed analysis of the ESMR-6/ snow relationships. Data were analyzed for February 1976 for site 1 and January, February and March 1976 for site 2. Snowpack water equivalents were less than 4.5 inches for site 1 and, depending on the month, were between 2.9 and 14.5 inches for site 2. A statistically significant relationship was found between ESMR-6 measurements and snowpack water equivalents for the Site 2 February and March data. Associated analysis findings presented are the effects of random measurement errors, snow site physiolography, and weather conditions on the ESMR-6/snow relationship.

N78-21573*# ECON, Inc., Princeton, N. J.

THE FIRST SEASAT-A INDUSTRIAL USERS WORKSHOP

Kenneth W. Hicks 10 Feb. 1978 322 p refs Workshop held at Princeton, N. J., 29-30 Nov. 1977

(Contract NASw-3047)

(NASA-CR-156149) Avail: NTIS HC A14/MF A01 CSCL 05B

The purpose of this workshop was to begin the process of definition and development of the SEASAT-A Demonstration Program, leading to the implementation of a set of experiments which would begin during the latter part of 1978 following the launch of SEASAT-A (now scheduled for May 1978). NASA through the SEASAT-A program, has encouraged the planning of cooperative experiments by industry and government agencies that operate in areas of ocean activity that could benefit from improved measurements and forecasts of weather and ocean conditions. The objectives of these experiments are to: (1) evaluate the significance of SEASAT-A data to commercial user organizations; (2) assist in identifying those characteristics of follow-on systems that are important to industrial users; (3) obtain experimental evidence that could be used to refine estimates of the economic potential of an operational system; and (4) begin the technology transfer process to the industrial users. Author

N78-21574*# Lockheed Electronics Co., Houston, Tex.

A MODEL OF THE 0.4-GHz SCATTEROMETER

S. T. Wu Jan. 1978 131 p refs
(Contract NAS9-15200)
(NASA-CR-151693; LEC-11087) Avail: NTIS HC A07/MF A01 CSCL 20F

The 0.4 GHz aircraft scatterometer system used for the agricultural soil moisture estimation program is analyzed for the antenna pattern, the signal flow in the receiver data channels, and the errors in the signal outputs. The operational principal, system sensitivity, data handling, and resolution cell length requirements are also described. The backscattering characteristics of the agriculture scenes are contained in the form of the functional dependence of the backscattering coefficient on the incidence angle. The substantial gains of the cross-polarization term of the horizontal and vertical antennas have profound effects on the cross-polarized backscattered signals. If these signals are not corrected properly, large errors could result in the estimate of the cross-polarized backscattering coefficient. It is also necessary to correct the variations of the aircraft parameters during data processing to minimize the error in the 0 degree estimation. Recommendations are made to improve the overall performance of the scatterometer system. Author

N78-21575*# National Aeronautics and Space Administration, Washington, D. C.
USE OF SATELLITE IMAGES IN THE EVALUATION OF FARMLANDS
Ana Estela Lozano H. Mar. 1978 9 p Transl. into ENGLISH of conf. paper from Secy. of Agriculture and Water Resources, Mex. Presented at UN/FAO Regional Training Seminar on the Application of Satellite Remote Sensing, La Paz, Bolivia, 1-9 Dec. 1977 p 1-5 Transl. by Sci. Transl. Serv., Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75088) Avail: NTIS HC A02/MF A01 CSCL 02C

Remote sensing techniques in the evaluation of farmland in Mexico are discussed. Electronic analysis techniques and photointerpretation techniques are analyzed. Characteristics of the basic crops in Mexico as related to remote sensing are described. Author

N78-21576# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DISTRIBUTED SENSOR NETWORKS Semiannual Technical Summary Report, 1 Jan. - 30 Sep. 1977
Richard T. LaCoss 30 Sep. 1977 36 p refs
(Contract F19628-76-C-0002; ARPA Order 3345)
(AD-A050160; ESD-TR-77-279) Avail: NTIS HC A03/MF A01 CSCL 09/2

Progress on the selection of a Distributed Sensor Networks program application problem, discussion of system elements, formulation and testing of multisite detection and location algorithms, and review of the fundamentals of sensitivity analysis are reported. Design and execution of an acoustic/seismic field experiment, and analysis and evaluation of experimental data including preliminary determination of acoustic detection ranges, spectral signatures, and direction determination capabilities are also described. Author (GRA)

N78-21577# Army Engineer Topographic Labs., Fort Belvoir, Va.
CHEMICAL ARRAY STUDIES Research Note, 1974 - 1977
Pi-Fuay Chen and James W. Gladden Dec. 1977 25 p refs
(DA Proj. 4A1-61102-B-52C)
(AD-A050024; ETL-0130) Avail: NTIS HC A02/MF A01 CSCL 17/8

The feasibility of developing continuous photoconductive layer arrays for mapping applications was studied. The procedures for preparing both the zinc oxide binder resin, and the undoped sintered cadmium sulfide, continuous photoconductive layers are presented. Special configuration area arrays with large multi-electrodes for beam centering purposes and for diffraction pattern detectors were devised. The mapping applications of the chemical arrays such as position detection, area, and center of mass measurements of uniformly dense-image patterns are described. Both zinc oxide and cadmium sulfide photoconductive layers were used to fabricate one- and two-dimensional arrays. Successful results were obtained for a one-dimensional 10-wire electrode, linear array. The fabrication of area chemical arrays were not successful. To fabricate a workable special configuration area array, more sophisticated methods such as sputtering and vacuum deposition techniques are necessary. A negligible error was obtained for the analysis of chemical arrays as position detection and area measurement. A larger error resulted for the center of mass measurement. Author (GRA)

N78-21578# SRI International Corp., Menlo Park, Calif.
INTERACTIVE AIDS FOR CARTOGRAPHY AND PHOTO INTERPRETATION Semiannual Technical Report, 12 May - 11 Nov. 1977
Harry G. Barrow Dec. 1977 53 p refs
(Contract DAAG29-76-C-0057; ARPA Order 2894)
(AD-A049768) Avail: NTIS HC A04/MF A01 CSCL 14/5

The ARPA Image Understanding Project at SRI has the scientific goal of investigating and developing ways in which diverse sources of knowledge may be used to interpret images automatically. The research is focused on the specific problems entailed in interpreting aerial photographs for cartographic and intelligence purposes. A key concept is the use of a generalized digital map to guide the process of image interpretation. In the past six months, the components developed under this project have been integrated into a single system, known as Hawkeye. The system includes modules for handling a large knowledge base in the form of a semantic net and terrain data files for using a raster-scan display and graphics tablets, for running task-specific subsystems, and for communicating with the user via graphics and in English. GRA

N78-21579# Ecology Consultants, Inc., Fort Collins, Colo.
ANNOTATED BIBLIOGRAPHY OF NATURAL RESOURCE INFORMATION: NORTHWESTERN COLORADO Final Report
Timothy W. Joseph Sep. 1977 195 p
(Contract DI-14-16-0008-2156)
(PB-275997/5; FWS/OBS-77/35; LC-77-90963) Avail: NTIS HC A09/MF A01 CSCL 06F

The flora, fauna and selected physical characteristics of the ecological test area are presented. Subject, author, geographic and species indexes are included. GRA

N78-21580# Colorado State Univ., Fort Collins.
ANALYSES OF METHODS FOR THE DETERMINATION OF WATER AVAILABILITY FOR ENERGY DEVELOPMENT
May 1977 128 p refs Sponsored in part by ERDA Prepared in cooperation with Colorado Div. of Water Resources, Denver
(Contract FEA-CA-05-50041-00)
(FEA/G-77/059) Avail: NTIS HC A07/MF A01

How computer programs, using hydrologic, climatic, legal and economic data, could be used to provide information for use by planners and water administrators in evaluating the impact of water availability on energy development is demonstrated. This included definition of the types of information needs, evaluation of existing computer program capabilities, analyses of data requirements for specific computer programs and/or to provide the specific information, selection of a group of computer programs that could provide the various levels of needed information, linking the computer programs to data sources, and applying the specific methodologies to a prototype area to demonstrate how specific information would be made available for use in the decision process. ERA

N78-21581# Geological Survey, Tacoma, Wash. Water Resources Div.
WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976. VOLUME 1: WESTERN WASHINGTON Annual Report, 1 Oct. 1975 - 30 Sep. 1976
Oct. 1977 417 p 2 Vol.
(PB-275886/0; USGS/WRD/HD-77/058;
USGS/WDR/WA-76/1) Avail: NTIS HC A18/MF A01 CSCL 13B

Water resources data for the 1976 water year for Washington, consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells and springs. This report, in two volumes, contains discharge records for 248 gaging stations; stage only records for 3 gaging stations; stage and contents for 44 lakes and reservoirs; water quality for 124 stations, and 8 lakes; and water levels for 108 observation wells. Also included are 172 crest-stage partial-record stations. GRA

N78-21582# Geological Survey, Tacoma, Wash. Water Resources Div.
WATER RESOURCES DATA FOR WASHINGTON, WATER YEAR 1976. VOLUME 2: EASTERN WASHINGTON Annual Report, 1 Oct. 1973 - 30 Sep. 1976
Oct. 1977 356 p 2 Vol.
(PB-275887/8; USGS/WRD/HD-77/059; USGS/WDR/WA-76/2) Avail: NTIS HC A16/MF A01 CSCL 13B

For abstract, see N78-21581.

N78-21583# Geological Survey, Tallahassee, Fla. Water Resources Div.
AQUIFER TEST ANALYSES FOR THE FLORIDAN AQUIFER IN FLAGLER, PUTNAM, AND ST. JOHNS COUNTIES, FLORIDA
C. B. Bentley Nov. 1977 57 p refs Sponsored in part by St. Johns River Water Management District
(PB-275790/4; USGS-WRI-77-36; USGS/WRD/WRI-78/006) Avail: NTIS HC A04/MF A01 CSCL 08H

Aquifer tests completed during the investigation and several tests made previously were analyzed for transmissivity, storage coefficient, and leakance of the confining beds. The analyses indicated a transmissivity of about 60,000 feet squared per day and a storage coefficient of about 0.0008 for the aquifer in the area of investigation. Applications presented include the generation of drawdown curves for pumping time, distance from a discharging well, and depth of penetration into the aquifer; and to estimate the seasonal and annual pumpage in a heavily pumped farming area. GRA

N78-21584# National Environmental Satellite Service, Washington, D. C.
LAKE ERIE ICE: WINTER 1975 - 1976
Jenifer H. Wartha Aug. 1977 76 p refs
(PB-276386/0; NOAA-TM-NESS-90; NOAA-77120101) Avail: NTIS HC A05/MF A01 CSCL 04B

The formation, movement, and decay of lake ice were traced. Wind speeds and directions were correlated with ice movement, and air temperatures were related to ice formation and dissipation. GRA

N78-21585# National Academy of Sciences - National Research Council, Washington, D. C.
HELIUM: A PUBLIC POLICY PROBLEM
1978 235 p refs
(Contract DI-BM-JQ-188017)
(PB-276040/3; BM-OFR-1-78) Avail: NTIS HC A11/MF A01 CSCL 08I

Helium will continue to be an essential resource and demand will be substantial in comparison with present demand. The report concludes that the present helium stored in the Cliffside field should be designated as a national strategic reserve, public policy on helium should no longer be based solely on Federal Government needs, but on national requirements, and that the current venting of helium should be stopped. Suggested inducements to accomplish such action include certain tax incentives, government loans, or government guarantees on private loans, free storage, and a government guarantee of nonintervention in the helium market through retention of the helium stockpile. GRA

N78-21586# Geological Survey, Menlo Park, Calif. Water Resources Div.
WATER RESOURCES DATA FOR CALIFORNIA, WATER YEAR 1976. VOLUME 3: SOUTHERN CENTRAL VALLEY BASINS, AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKE RIVER Annual Report, 1 Oct. 1975 - 30 Sep. 1976
Dec. 1977 412 p Prepared in cooperation with Calif. State Dept. of Water Resources
(PB-276354/8; USGS/WRD/HD-77/056; USGS/WDR/CA-76/3) Avail: NTIS HC A18/MF A01 CSCL 13B

Records of stage, discharge, and water quality of streams; stage, contents, and water quality in lakes and reservoirs; and water levels in wells were reported. This report contains discharge records in 180 gaging stations, stage and contents of 42 lakes and reservoirs, water quality for 44 stations and one well, and water levels for 14 observation wells. Included were 33 crest stage partial record stations, 25 low flow partial record stations, and eight water quality partial record stations. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N78-21587 Maryland Univ., College Park.
MODELING OF RANKINE CYCLE/VAPOR COMPRESSION CYCLE COOLING SYSTEMS FOR SOLAR ENERGY APPLICATIONS Ph.D. Thesis
Akife Niluefer Egrican 1977 219 p
Avail: Univ. Microfilms Order No. 78-00374

Solar cooling system computer simulations were utilized in the determination of daily and seasonal cooling performance and in determining design values such as cooling capacity, collector area, storage size, and sizes of pumps and piping. RC/VCC solar cooling systems converted collected solar heat into a cooling effect. This was accomplished at the site of the installation by using the Rankine cycle to generate the shaft work required to drive a vapor compression cycle. The onsite solar powered Rankine cycle differs from a central station Rankine cycle in that the solar powered Rankine cycle operated at a much lower boiler temperature consistent with the use of flat plate or low concentration ratio collectors. Design and off design techniques were developed which took into account heat transfer effects and rotational component inefficiencies. Dissert. Abstr.

N78-21588 Stanford Univ., Calif.
EVALUATION OF LITHIUM TITANATES AS CATHODE MATERIALS Ph.D. Thesis
Bruce Eric Liebert 1977 257 p
Avail: Univ. Microfilms Order No. 7802195

Polycrystalline samples with the ramsdellite structure were electrochemically titrated with lithium in a lithium chloride potassium chloride eutectic melt and were found to irreversibly transform the spinel structure after only minor amounts of lithium were inserted. The spinel structure was able to accommodate up to one lithium per formula unit before transforming to the sodium chloride structure. The transport properties of lithium were studied using nuclear magnetic resonance, ac conductivity, and on electrochemical technique. The Chemical diffusion coefficient was measured in each phase using the galcanostatic intermittent titration technique. Dissert. Abstr.

N78-21589*# IBM Federal Systems Div., Huntsville, Ala.
SYSTEM DESIGN PACKAGE FOR IBM SYSTEM ONE: SOLAR HEATING AND DOMESTIC HOT WATER
Feb. 1977 174 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150614) Avail: NTIS HC A08/MF A01 CSCL 10A

This report is a collation of documents and drawings that describe a prototype solar heating and hot water system using air as the collector fluid and a pebble bed for heat storage. The system was designed for installation into a single family dwelling. The description, performance specification, subsystem drawings, verification plan/procedure, and hazard analysis of the system was packaged for evaluation of the system with information sufficient to assemble a similar system. Author

N78-21590*# Joint Center for Graduate Study, Richland, Wash.
SPACE ELECTRIC POWER DESIGN STUDY
W. R. Martini Dec. 1976 126 p refs
(NASA Order A-29674B)
(NASA-CR-152031) Avail: NTIS HC A07/MF A01 CSCL 10A

The conversion of laser energy to electrical energy is discussed. Heat engines in which the laser heats the gas inside the engine through a window as well as heat engines in which the gas is heated by a thermal energy storage reservoir which has been heated by laser radiation are both evaluated, as well as the necessary energy storage, transmission and conversion components needed for a full system. Preliminary system concepts are presented and a recommended development program is outlined. It appears possible that a free displacer Stirling engine operating directly a linear electric generator can convert 65% of the incident laser energy into electricity. Author

N78-21591*# Elcam, Inc., Santa Barbara, Calif.
PROTOTYPE SOLAR HEATED HOT WATER SYSTEMS AND DOUBLE-WALLED HEAT EXCHANGERS: A COLLECTION OF QUARTERLY REPORTS Contractor Report, Sep. 1976 - Dec. 1977
Jan. 1978 34 p Prepared for DOE
(Contract NAS8-32245)
(NASA-CR-150591) Avail: NTIS HC A03/MF A01 CSCL 10A

The plan schedule and status of multiple objectives to be achieved in the development, manufacture, installation, and maintenance of two solar heated hot water prototype systems and two heat exchangers are reported. A computer program developed to resolve problems and evaluate system performance is described. Author

N78-21592*# Houston Chemical Co., Corpus Christi, Tex.
SOLAR HEAT TRANSPORT FLUID Quarterly Report, Nov. 1977 - Jan. 1978
Feb. 1978 18 p Prepared for DOE
(Contract NAS8-32255)
(NASA-CR-150612) Avail: NTIS HC A02/MF A01 CSCL 10A

The progress made on the development and delivery of noncorrosive fluid subsystems is reported. These subsystems are to be compatible with closed-loop solar heating or combined heating and hot water systems. They are also to be compatible with both metallic and non-metallic plumbing systems. At least 100 gallons of each type of fluid recommended by the contractor will be delivered under the contract. The performance testing of a number of fluids is described. Author

N78-21593*# IBM Federal Systems Div., Huntsville, Ala.
SYSTEM DESIGN PACKAGE FOR SOLAR HEATING AND COOLING SITE DATA ACQUISITION SUBSYSTEM
Mar. 1978 135 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150606) Avail: NTIS HC A07/MF A01 CSCL 10A

The Site Data Acquisition Subsystem (SDAS) designed to collect data from sensors located on residential or commercial buildings using a solar heating and/or cooling system is described. It takes the data obtained from sensors located on the solar system, processes the data into suitable format, stores the data for a period of time, and provides the capability for either telephone retrieval by the central data processing system or manual retrieval of the data for transfer to a central site. The SDAS is also designed so that it will not degrade the operation of the solar heating/cooling system which it is monitoring. Author

N78-21594*# IBM Federal Systems Div., Huntsville, Ala.
SYSTEMS INTEGRATION OF MARKETABLE SUBSYSTEMS: A COLLECTION OF PROGRESS REPORTS Contractor Report, Jan. 1977 - Jan. 1978
Mar. 1978 207 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150587) Avail: NTIS HC A10/MF A01 CSCL 10A

Monthly progress reports are given in the areas of marketable subsystems integration; development, design, and building of site data acquisition subsystems and data processing systems; operation of the solar test facility and a systems analysis.Author

N78-21595*# IBM Federal Systems Div., Huntsville, Ala.
CENTRAL DATA PROCESSING SYSTEM (CDPS) USER'S MANUAL: SOLAR HEATING AND COOLING PROGRAM
Sep. 1976 168 p Prepared for DOE
(Contract NAS8-32036)
(NASA-CR-150580; IBM-7933252) Avail: NTIS HC A08/MF A01 CSCL 10A

The software and data base management system required to assess the performance of solar heating and cooling systems installed at multiple sites is presented. The instrumentation data associated with these systems is collected, processed, and presented in a form which supported continuity of performance evaluation across all applications. The CDPS consisted of three major elements: communication interface computer, central data processing computer, and performance evaluation data base. Users of the performance data base were identified, and procedures for operation, and guidelines for software maintenance were outlined. The manual also defined the output capabilities of the CDPS in support of external users of the system. Author

N78-21596*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFLUENT CHARACTERIZATION FROM A CONICAL PRESSURIZED FLUID BED
R. J. Priem, R. J. Rollbuhler, and R. W. Patch Dec. 1977 15 p refs Presented at the 5th Intern. Conf. on Fluidized-Bed Combust., Washington, D. C., 12-14 Dec. 1977
(NASA-TM-73897; E-9524) Avail: NTIS HC A02/MF A01 CSCL 10A

To obtain useable corrosion and erosion results it was necessary to have data with several levels of particulate matter in the hot gases. One level of particulate loading was as low as possible so that ideally no erosion and only corrosion occurred. A conical fluidized bed was used to obtain some degree of filtration through the top of the bed which would not be highly fluidized. This would minimize the filtration required for the hot gases or conversely the amount of particulate matter in the hot gases after a given level of filtration by cyclones and/or filters. The data obtained during testing characterized the effluent from the bed at different test conditions. A range of bed heights, coal flows, air flows, limestone flows, and pressure are represented. These tests were made to determine the best operating conditions prior to using the bed to determine erosion and corrosion rates of typical turbine blade materials. Author

N78-21597*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OWENS-ILLINOIS LIQUID SOLAR COLLECTOR MATERIALS ASSESSMENT
R. L. Nichols Mar. 1978 36 p Prepared for DOE
(NASA-TM-78163) Avail: NTIS HC A03/MF A01 CSCL 10A

From the beginning, it was noted that the baseline drawings for the liquid solar collector exhibited a distinct weakness concerning materials specification where elastomers, plastics, and foam insulation materials were utilized. A relatively small effort by a competent design organization would alleviate this deficiency. Based on results obtained from boilout and stagnation tests on the solar simulator, it was concluded that proof testing of the collector tubes prior to use helps to predict their performance for limited service life. Fracture mechanics data are desirable for predicting extended service life and establishing a minimum proof pressure level requirement. The temperature capability of this collector system was increased as the design matured and the coating efficiency improved. This higher temperature demands the use of higher temperature materials at critical locations in the collector. Author

N78-21598*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESULTS OF THE 1974 THROUGH 1977 NASA/JPL BALLOON FLIGHT SOLAR CELL CALIBRATION PROGRAM
L. B. Sidwell 15 Jan. 1978 30 p refs
(Contract NAS7-100)
(NASA-CR-156180; JPL-Pub-77-82) Avail: NTIS HC A03/MF A01 CSCL 10A

From 1974 through 1977, seven solar cell calibration flights and two R&D flights with a spectroradiometer as a payload were attempted. There were two R&D flights, and one calibration flight that failed. Each calibration flight balloon was designed to carry its payload to an altitude of 36.6 km (120 kft). The R&D

flight balloons were designed for a payload altitude of 47.5 km (150 kft). At the end of the flight period, the upper (solar cell calibration system) and lower (consolidated instrument package (DIP) payloads were separated from the balloon and descend via parachutes. The calibrated solar cells recovered in this manner were used as primary intensity reference standards during solar simulator testing of solar cells and solar arrays with similar spectral response characteristics. This method of calibration has become the most widely accepted technique for developing space standard solar cells. Author

N78-21599*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SMALL POWER SYSTEMS SOLAR ELECTRIC WORKSHOP PROCEEDINGS. VOLUME 1: EXECUTIVE REPORT. VOLUME 2: INVITED PAPERS
R. Ferber, ed. and D. Evans, ed. Feb. 1978 24 p Workshop held at Aspen, Colo., 10-12 Oct. 1977
(Contract NAS7-100)
(NASA-CR-156165; JPL-Pub-78-10-Vol-1; DOE/JPL-1060-78/1) Avail: NTIS HC A02/MF A01 CSCL 10B

The background, objectives and methodology used for the Small Power Systems Solar Electric Workshop are described, and a summary of the results and conclusions developed at the workshop regarding small solar thermal electric power systems is presented. Author

N78-21600*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STRUCTURE OF DEFORMED SILICON AND IMPLICATIONS FOR LOW COST SOLAR CELLS
N. Mardesich, M. H. Leipold, G. B. Turner, and T. G. Digges, Jr. 1 Mar. 1978 25 p refs Prepared for DOE
(Contract NAS7-100)
(NASA-CR-156166; JPL-Pub-78-13; DOE/JPL-1012-78/3) Avail: NTIS HC A02/MF A01 CSCL 10A

The microstructure and minority carrier lifetime of silicon were investigated in uniaxially compressed silicon samples. The objective of the investigation was to determine if it is feasible to produce silicon solar cells from sheet formed by high temperature rolling. The initial structure of the silicon samples ranged from single crystal to fine-grained polycrystals. The samples had been deformed at strain rates of 0.1 to 8.5/sec and temperatures of 1270-1380 C with subsequent annealing at 1270-1380 C. The results suggest that high temperature rolling of silicon to produce sheet for cells of high efficiency is not practical. Author

N78-21601*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CHARACTERIZATION OF SOLAR CELLS FOR SPACE APPLICATIONS. VOLUME 1: ELECTRICAL CHARACTERISTICS OF OCLI VIOLET SOLAR CELLS AS A FUNCTION OF INTENSITY AND TEMPERATURE
T. A. Casad, R. G. Downing, and R. S. Weiss 15 Mar. 1978 38 p
(Contract NAS7-100)
(NASA-CR-156162; JPL-Pub-78-15-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 10A

Electrical characteristics of OCLI violet N/P silicon solar cells are presented in graphical and tabular format as function of solar illumination intensity and temperature. Author

N78-21602*# Life Sciences Engineering, Morrison, Colo.
SUBSYSTEM DESIGN PACKAGE FOR SOLAR II COLLECTOR Contractor Report, May 1977 - Dec. 1977
Jan. 1978 38 p Prepared for DOE
(Contract NAS8-32261)
(NASA-CR-150611) Avail: NTIS HC A03/MF A01 CSCL 10A

The requirements for the design and performance of the Solar 2 Collector Subsystem developed for use in solar heating of single family residences and mobile homes are presented. Installation drawings are included. J.M.S.

N78-21603*# Solar Engineering and Mfg. Co., Deerfield Beach, Fla.
PRELIMINARY DESIGN PACKAGE FOR SOLAR HOT WATER SYSTEM
Dec. 1977 18 p refs Prepared for DOE
(Contract NAS8-32248)
(NASA-CR-150617) Avail: NTIS HC A02/MF A01 CSCL 10A

This package includes technical information, schematics, drawings and brochures of the solar hot water system. This system consists of the following subsystems: collector, storage, transport, control, auxiliary energy, and Government-furnished site data acquisition. The two units being manufactured will be installed at Loxahatchee, Florida, and Macon, Georgia. Author

N78-21604*# Owens-Illinois, Inc., Toledo, Ohio.
DEVELOPMENT OF PROTOTYPE AIR/LIQUID SOLAR COLLECTOR SUBSYSTEM Quarterly Report, 1 Nov. 1977 - 31 Jan. 1978
Jan. 1978 9 p Prepared for DOE
(Contract NAS8-32259)
(NASA-CR-150627; QR-5) Avail: NTIS HC A02/MF A01 CSCL 10A

The installation and layout design, and parts fabrication are described. The master development schedule for the design of the system is also included. Author

N78-21605*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala. Structures and Propulsion Lab.
USE OF THE MARSHALL SPACE FLIGHT CENTER SOLAR SIMULATOR IN COLLECTOR PERFORMANCE EVALUATION
William R. Humphries Apr. 1978 128 p refs Prepared for DOE
(NASA-TM-78165) Avail: NTIS HC A07/MF A01 CSCL 10A

Actual measured values from simulator checkout tests are detailed. Problems encountered during initial startup are discussed and solutions described. Techniques utilized to evaluate collector performance from simulator test data are given. Performance data generated in the simulator are compared to equivalent data generated during natural outdoor testing. Finally, a summary of collector performance parameters generated to date as a result of simulator testing are given. Author

N78-21606*# Aeronutronic Ford Corp., Palo Alto, Calif. Western Development Labs.
SMS/GOES CELL AND BATTERY DATA ANALYSIS REPORT Final Report
Jon D. Armantrout Dec. 1977 376 p
(Contract NAS5-23693)
(NASA-CR-156739; WDL-TR-7529) Avail: NTIS HC A17/MF A01 CSCL 10C

The nickel-cadmium battery design developed for the Synchronous Meteorological Satellite (SMS) and Geostationary Operational Environmental Satellite (GOES) provided background and guidelines for future development, manufacture, and application of spacecraft batteries. SMS/GOES battery design, development, qualification testing, acceptance testing, and life testing/mission performance characteristics were evaluated for correlation with battery cell manufacturing process variables. Author

N78-21607# Tennessee Univ., Knoxville. Environment Center.
ENERGY CONSERVATION IN THE HOME: AN ENERGY EDUCATION/CONSERVATION CURRICULUM GUIDE FOR HOME ECONOMICS TEACHERS
Lil Clinard and Nancy Collins Oct. 1977 332 p refs
(Contract EY-76-S-05-5049)
(EDM-1028) Avail: NTIS HC A15/MF A01

A guide designed for home economics teachers as a source of information, instructional materials, and suggested references about the energy situation as a whole, energy concepts, and the use of energy in the home is presented. Emphasis is placed on conservation measures applicable to the home. J.M.S.

N78-21608# Open Univ., Milton (England).
COMBINED HEAT AND POWER: A DISCUSSION OF ENERGY PAPER 20
Rosalind Armson Jun. 1977 51 p refs
(ERG-018) Avail: NTIS HC A04/MF A01; Secretary, Energy Research Group, Milton Keynes, Engl. HC £2.50

The implications of a combined heat and power (CHP) district heating program were examined. The system used a modified steam cycle so that heat at a temperature of 100 C could be bled off and sold to consumers. Thermodynamic efficiency of the cycle depended upon the difference between the upper and lower temperatures; an increase in the lower temperature decreased the efficiency of generation of electricity. The CHP was discussed in terms of cost effectiveness, heating strategies, insulation, solar technology, and social factors. Author

N78-21609# Open Univ., Milton (England).
INTEGRATING WAVE POWER INTO THE ELECTRICITY SUPPLY SYSTEM
Deua Vimukta Dec. 1977 17 p refs
(RR-20) Avail: NTIS HC A02/MF A01; Secretary, Energy Research Group, Milton Keynes, Engl. HC £1.00

As a source of electricity wave power has two distinctive features, one favorable - its good seasonal correlation with demand - and one unfavorable - its unpredictability. Data on wave-power was combined with a previously developed model of seasonal and diurnal variations in electricity supply, using Monte-Carlo methods, to calculate the effect of wave power upon the load-duration curve and hence upon the electricity supply as a whole. It seems from the results that while a small wave power program could usefully have a high power cutoff so as to use the power available in winter storm surges, any program designed to make a substantial contribution to electricity supply would have to concentrate on cheap and reliable delivery of the power available below a quite low cutoff (approximately 25 kW/m). Author

N78-21610# Committee on Public Works and Transportation (U. S. House).
USE OF SOLAR ENERGY IN FEDERAL BUILDINGS
Washington GPO 1977 308 p refs Hearings on H.R. 5821, H.R. 5778, H. Res. 322 and H.R. 6831 (sections 721 through 746) before Subcomm. on Public Buildings and Grounds of the Comm. on Public Works and Transportation, 95th Congr., 1st Sess., 2-4 May and 22-23 Jun. 1977
(GPO-94-365) Avail: Subcomm. on Public Buildings and Grounds

Presented are testimonies, bills and acts for the use of solar energy in Federal Buildings. The bills are designed to insure energy conservation by development of renewable and inexhaustable energy sources to insure long term economic growth. The bills will allow Government to provide leadership which will then be passed on to the private sector. A program is presented to promote the use of commonly accepted methods to establish and compare the life-cycle costs of operating residential, commercial and industrial buildings, and the life-cycle fuel and energy requirements of such buildings. A five year energy-in-Government program is established for the procurement and installation of solar systems for hot water, space heating and electricity production in new and existing Federal Buildings. GY

N78-21611*# National Aeronautics and Space Administration, Washington, D. C.
SPACE SOLAR POWER. DESCRIPTION OF CONCEPT, RESULTS OF PRELIMINARY STUDIES, REQUIREMENTS FOR EVALUATION
30 Mar. 1977 21 p
(NASA-TM-79436) Avail: NTIS HC A02/MF A01 CSCL 10A

The nation is actively pursuing alternate sources of energy because of the problems or concerns related to obtaining required energy for the future from oil, gas, nuclear, and coal sources. Solar energy is an obvious candidate for consideration. Its use in the past has been limited by the relative cost of collecting and converting solar energy into electrical power. The increasing costs of other energy sources will make solar energy more attractive. During recent years a new concept for the collection of solar energy has been developed. This concept involves the location of solar power stations in space. The concept, results of preliminary studies, and requirements for space evaluation of such a project are discussed. Author

N78-21612*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SOLAR POWER SATELLITES
Christopher C. Kraft, Jr. [1977] 7 p
(NASA-TM-79434) Avail: NTIS HC A02/MF A01 CSCL 10A

A satellite based energy concept is described, including the advantages of the basic concept, system characteristics, cost, and environmental considerations. An outline of a plan for the further evaluation and implementation of the system is given. It is concluded that the satellite concept is competitive with other advanced power generation systems when a variety of factors are considered, including technical feasibility, cost, safety, natural resources, environment, baseload capability, location flexibility, land use, and existing industrial base for implementation. Author

N78-21613# Committee on Finance (U. S. Senate).
INCENTIVES FOR DEVELOPING NEW ENERGY SOURCES
Washington GPO 1977 248 p refs Hearings before Subcomm. on Energy and Foundations of the Comm. on Finance, 95th Congr., 1st Sess., 20-21 Jun. 1977
(GPO-93-810) Avail: SOD

Testimony was given by all sectors of the energy community in an attempt to define the problems in energy production and to clarify the alternatives available with existing technology. Some of the energy technologies discussed were: coal gasification, geothermal utilization, organic waste conversion, and solar energy. Various economic incentives were proposed to encourage energy exploration and development by industry. P.R.A.

N78-21614# Naval Weapons Support Center, Crane, Ind. Weapons Quality Engineering Center.
ENGINEERING EVALUATION TESTS OF 3-4 AMPERE-HOUR SEALED LEAD-ACID BATTERIES ELPOWER, ESB, EAGLE-PITCHER, GLOBE UNION AND GATES
A. W. Goodman 7 Dec. 1977 16 p
(AD-A049445; WQEC/C-77-395) Avail: NTIS HC A02/MF A01 CSCL 10/3

The program objective was to evaluate and determine: high rate capability, low temperature performance, a plot of discharge time versus various discharge rates, life cycle capability, and charging requirements. GRA

N78-21615# Army Facilities Engineering Support Agency, Fort Belvoir, Va. Research and Technology Div.
INSTALLATION ENERGY CONTROL SYSTEM ANALYSIS PROGRAM Final Report
Harold D. Hollis, Casimir A. Kukielka, and Peter E. Baum 1 Jun. 1977 85 p refs
(DA Proj. 4A7-62731-AT-41)
(AD-A049488; USAFESA-RT-2) Avail: NTIS HC A05/MF A01 CSCL 13/1

The Installation Energy Control System Analysis Program uses previously developed methods, to estimate the cost and savings of an energy control system. The program uses the guidance found in AR-11-28 to calculate the present worth of options analyzed and compares them against the baseline where no system has been employed, i.e., no savings. Simple payback is also calculated using the Energy Conservation Investment Program (ECIP) guidance. This report explains the meaning of the input data, how the program is exercised and the interpretation of the output. The appendices contain input forms, a source listing of the program and a sample program output. Author (GRA)

N78-21616# Naval Postgraduate School, Monterey, Calif.
SOLAR ENERGY FOR THE NAVAL SHORE ESTABLISHMENT M.S. Thesis
Bruce Burgee Geibel Dec. 1977 249 p refs
(AD-A050026) Avail: NTIS HC A11/MF A01 CSCL 03/2

This thesis discusses the background and extent of the current national energy crisis, and reviews the alternative energy sources available to the United States Navy other than conventional fossil fuels. An in-depth analysis is made of the advantages, disadvantages and techniques of one of these alternatives, solar energy conversion. The National Solar Energy Program is reviewed, as is the role of the Department of Defense and the United States Navy in this program. Methods of 'retrofitting' existing Navy facilities with solar energy systems are discussed, as are new construction techniques. The thesis further contains techniques for life-cycle costing of alternative solar energy systems, which include computer model programs such as BASIC Language,

F-Chart calculations, and SOLCOST calculations. The thesis concludes with suggestions for establishing a viable solar energy program on an activity or individual basis. A comprehensive reference list and bibliography is provided to identify where technical and engineering details can be found. Author (GRA)

N78-21617# Power Conversion, Inc., Mount Vernon, N. Y.
MANUFACTURING METHODS AND TECHNOLOGY FOR HERMETICALLY SEALED LITHIUM SO2 CELL BATTERIES Quarterly Report, 1 Oct. - 31 Dec. 1976
T. Watson Jan. 1977 59 p refs
(Contract DAAB07-76-C-0042)
(AD-A049943; TR-0042-Q-02; QR-2) Avail: NTIS HC A04/MF A01 CSCL 10/3

Effort is continuing on the MM and T program to establish the fabrication techniques and requirements necessary to meet hardware production levels as specified in the subject contract. The PERT/TIME Network has been revised and expanded to define specific problem areas and establish a corrective action plan to meet the overall program objectives within the scheduled time frame. Hermetic cell and battery components design has been revised in an effort to meet and/or exceed all performance specifications at minimum current density levels. Non-hermetic cell samples are presently being fabricated and tested under various thermal discharge profiles to simulate the proposed hermetic designs. Such results will aid in the final selection of the optimal design configuration for the hermetic prototypes. Initial equipment design and fabrication of core winding, cathode/anode manufacture, hermetic closure and electrolyte preparation and dispensing is presently underway to permit subsequent integration within an operational production line. Interface with automated equipment manufacturers continue in order to fabricate specific machine elements and procure necessary hardware within the time frame of the PERT/TIME Network.
Author (GRA)

N78-21618# State Univ. of New York, Albany.
ENERGY CONSERVATION VIA SOLAR ENERGY APPLICATION TO MULTI-FAMILY AND COMMERCIAL STRUCTURES. VOLUME 2, PART 2: SOLAR ENERGY ATLAS FOR NEW YORK STATE
Bruce Bailey, James Healey, and Ronald Stewart 7 Sep. 1977 97 p
(PB-276130/2; ASRC-SUNY-Pub-419; NYSERDA-75/25) Avail: NTIS HC A05/MF A01 CSCL 04B

The Part 2 supplement of the atlas updates and broadens scope information included in the original atlas. Pyranometer data collected throughout New York State through 1975 are presented. Included are data organized by monthly, daily, and hourly means. Annual and monthly distribution maps for solar radiation are included for the 1970-1975 period. A climatological section provides monthly and annual distribution maps for several climatic parameters. GRA

N78-21619# General Accounting Office, Washington, D. C. International Div.
US ENERGY CONSERVATION COULD BENEFIT FROM EXPERIENCES OF OTHER COUNTRIES
10 Jan. 1978 41 p
(PB-276006/4; ID-78-4) Avail: NTIS HC A03/MF A01 CSCL 10A

Energy conservation policies and practices of four European countries are discussed. Information on those effective measures which seemed to be applicable to U.S. efforts are noted. GRA

N78-21620# Williamson Engineering Associates, Inc., Navarre, Fla.
THE APPLICATION OF WIND ENERGY SYSTEMS TO DESALINATION
William R. Williamson, John E. Westberg, and William R. Williamson 22 Apr. 1977 68 p refs
(Contract DI-14-34-0001-7523)
(PB-276174/0; W78-02701; OWRT/S-78/1) Avail: NTIS HC A04/MF A01 CSCL 10B

The application of wind energy systems to membrane processes for brackish water conversion is presented. Commercially available wind turbines and those under development were available for producing electrical energy at costs ranging from 5 cents down to 1.8 cents per kilowatt hour. It was still possible to reach costs for desalting brackish water at less than $1.00 per thousand gallons with large wind energy/desalination systems. The coupling of wind energy turbines to electrodialysis and reverse osmosis offered technological advantages, such as variable energy outputs from wind turbines, to optimize variable fluid flows in the desalination processes for maximum, economic production of potable water. Research and development efforts in this direction are indicated. GRA

N78-21621# Federal Energy Regulatory Commission, Washington, D. C. Office of Electric Power Regulation.
PROJECTED 1977 - 1978 WINTER ELECTRIC LOAD-SUPPLY SITUATION, CONTIGUOUS UNITED STATES
1 Dec. 1977 35 p
(PB-276269/8) Avail: NTIS HC A03/MF A01 CSCL 10A

Data concerning projected electrical peak loads and available power resources for the 1977-78 winter period are presented, as reported by electric utilities. GRA

N78-21622# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
STUDY OF TREATMENT METHODS FOR GEOTHERMAL FLUIDS
Sidney L. Phillips, Ashwani K. Mathur, and Raymond E. Doebler May 1977 13 p refs Presented at the SPE Intern. Symp. on Oilfield and Geothermal Chem., Calif. Univ., San Diego, 27-29 Jun. 1977
(Contract W-7405-eng-48)
(LBL-6337; Conf-770609-5) Avail: NTIS HC A02/MF A01

The methodology used to control geothermal scaling and corrosion was studied. The information used for this study was screened from the geothermal, oil and gas, waste water disposal, and boiler water treatment industries. Current methods of corrosion control center around planned replacement of piping and other plant components, development of materials with improved corrosion resistance. ERA

N78-21623# California Univ., Berkeley. Lawrence Berkeley Lab.
DISTRIBUTED TECHNOLOGIES IN CALIFORNIA'S ENERGY FUTURE, VOLUME 1
M. Christensen, ed., P. Craig, ed., C. B. McGuire, ed., and M. Simmons, ed. Sep. 1977 248 p refs
(Contract W-7405-eng-48)
(LBL-6831-Vol-1) Avail: NTIS HC A11/MF A01

Alternative energy sources based on renewable energy forms are considered in terms of development of distribution energy systems with emphasis on the California setting. Trends in energy supply and patterns of energy use are reviewed, energy resources are discussed including biomass, solar energy, geothermal energy, and wind energy, and environmental and land use factors are considered. Economic, social, and political issues are included. It is concluded that it is possible to run a complex, highly industrialized, post-industrial society entirely on renewable resources internal to the state, and that this can occur in the presence of growth in gross state product. J.M.S.

N78-21624# Waterloo Univ. (Ontario). Research Inst.
STUDIES ON METHODS OF REDUCING HEAT LOSSES FROM FLAT PLATE SOLAR COLLECTORS, PHASE 2 Annual Progress Report, 1 Feb. 1976 - 1 Jan. 1977
K. G. T. Hollands, G. D. Raithby, and T. E. Unny Jan. 1977 44 p refs
(Contract EY-76-C-02-2597)
(COO/2597-3) Avail: NTIS HC A03/MF A01

Free convective heat loss from V corrugated absorber plate to a plane glass cover, has shown that, for the same average spacing, the free convective heat loss was greater for a V corrugated absorber plate than for a plane absorber plate. However, provided the average spacing was large enough, the amount of increase was slight. Free convective heat loss in a honeycomb solar collector in which the honeycomb consisted of a set of horizontal partitions, or slits, has shown that provided the solar collector was tilted to near vertical, such a honeycomb gave better free convective loss suppression than did a square-celled honeycomb having the same amount of material. ERA

N78-21625# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
DESIGN METHOD FOR HEAT LOSS CALCULATION FOR IN-GROUND HEAT STORAGE TANKS
F. C. Hooper and C. R. Attwater 1977 6 p refs Presented at Winter Ann. Meeting of the Am. Soc. of Mechanical Engineers, Atlanta, Ga., 27 Nov. 1977
(Contract EY-76-C-02-2939)
(COO-2923-3; Conf-771120-4) Avail: NTIS HC A02/MF A01

A lumped parameter approach is used based on three indices evaluated for particular configurations from detailed computations. The method predicts the transient responses of large storages associated with annual heat storage solar heating systems. ERA

N78-21626# Georgia Univ., Athens. Dept. of Chemistry.
DEVELOPMENT OF A PRACTICAL PHOTOCHEMICAL ENERGY STORAGE SYSTEM Quarterly Report
R. R. Hautala and C. R. Kutal 15 Sep. 1977 40 p refs
(Contract EY-76-S-09-0893)
(SRO-893-6) Avail: NTIS HC A02/MF A01

It was found that the tripehnylcyclopropenyl-nickel compound was an active catalyst for the conversion of quadricyclene to norbornadiene. A variety of triphenylcyclopropenyl-nickel derivatives were synthesized in order to determine their structure activity relationships with respect to catalysis of the conversion of quadricyclene to norbornadiene. An approach to the development of a polymer bound catalyst for the conversion of quadricyclene to norbornadiene based on an ion exchange resin was also explored. ERA

N78-21627# Georgia Univ., Athens. Dept. of Chemistry.
DEVELOPMENT OF A PRACTICAL PHOTOCHEMICAL ENERGY STORAGE SYSTEM Quarterly Report
R. R. Hautala and C. R. Kutal 15 Mar. 1977 15 p refs
(Contract EY-76-S-09-0893)
(SRO-893-8) Avail: NTIS HC A02/MF A01

Research on polymer organic sensitizers and polymer inorganic sensitizers for the conversion of norbornadiene to quadricyclene for thermochemical storage of solar heat is described. Also, research on the catalysis of the conversion of quadricyclene to norbornadiene is described. ERA

N78-21628# Georgia Univ., Athens. Dept. of Chemistry.
DEVELOPMENT OF A PRACTICAL PHOTOCHEMICAL ENERGY STORAGE SYSTEM Annual Report, 15 Jun. 1976 - 14 Jun. 1977
R. R. Hautala and C. R. Kutal 15 Mar. 1977 16 p refs
(Contract EY-76-S-09-0893)
(SRO-893-9) Avail: NTIS HC A02/MF A01

Significant progress toward the development of a solar energy storage system based on the norbornadiene-quadricyclene interconversion was achieved. New sensitizers and catalysts were discovered and conditions found where single cycles of the photosensitization step and the catalytic reversion step appear to be quantitative. Both sensitizers and catalysts were successfully incorporated onto insoluble polymeric supports. The long term stability of these components is currently being tested using a recently constructed prototype device designed for multiple recycling experiments. Investigations are also underway on design modifications which will allow incorporation of the norbornadiene-quadricyclene system into currently available state-of-the-art solar collectors. ERA

N78-21629# Georgia Univ., Athens. Dept. of Chemistry.
DEVELOPMENT OF A PRACTICAL PHOTOCHEMICAL ENERGY STORAGE SYSTEM Quarterly Report
R. R. Hautala and C. R. Kutal 15 Jun. 1977 22 p refs
(Contract EY-76-S-09-0893)
(SRO-893-10) Avail: NTIS HC A02/MF A01

Research on polymeric organic sensitizers and polymeric inorganic sensitizers for the conversion of norbornadene to quadricyclene and catalysts for the conversion of quadricyclene to norbornadene is described. The interconversion of norbornadene and quadricyclene is studied for its possible use for thermochemical solar energy storage. ERA

N78-21630# San Diego Gas and Electric Co., Calif.
GEOTHERMAL ENVIRONMENTAL STUDIES, HEBER REGION, IMPERIAL VALLEY, CALIFORNIA. ENVIRONMENTAL BASELINE DATA ACQUISITION Final Report
Feb. 1977 308 p refs
(EPRI-ER-352) Avail: NTIS HC A14/MF A01

The Heber area of the Imperial Valley was selected as one of the candidate geothermal reservoirs. Documentation of the environmental conditions presently existing in the Heber area was required for assessment of environmental impacts of future development. An environmental baseline data acquisition program to compile available data on the environment of the Heber area was reported. The program included a review of pertinent existing literature, interviews with academic, governmental, and private entities, combined with field investigations and meteorological monitoring to collect primary data. Results of the data acquisition program were compiled in terms of three elements: the physical, the biological, and socioeconomic settings. ERA

N78-21631# California Univ., Berkeley. Lawrence Berkeley Lab.
RESULTS OF RESERVOIR EVALUATION TESTS, 1976 EAST MESA GEOTHERMAL FIELD, CALIFORNIA
T. N. Narasimhan, D. G. McEdwards, and P. A. Witherspoon Jul. 1977 11 p
(Contract W-7405-eng-48)
(LBL-6369) Avail: NTIS HC A02/MF A01

Two interference well tests were conducted to define the geothermal reservoir's geometry and hydrologic characteristics. Temperature profiles taken indicate that the reservoir is approximately 3000 feet thick and is located about 6000 feet below the ground surface. The temperature at depth is approximately 350 C. The two well tests, each of approximately 10 days' duration yield respectively reservoir transmissivities of 11,200 and 29,500 millidarcy-feet and compressibilities of 5.7 x .001 and 2.1 x .001 feet per psi. The tests also indicate the possible presences of a sealed fault and a leaky fault in the reservoir. ERA

N78-21632# Commonwealth Research Corp., Chicago, Ill.
GASIFICATION COMBINED CYCLE TEST FACILITY, PEKIN, ILLINOIS Monthly Technical Progress Report, 25 Jun. - 26 Jul. 1977
Aug. 1977 20 p refs
(Contract EF-77-C-01-2352)
(FE-2352-03) Avail: NTIS HC A02/MF A01

Progress in developing a prototype combined cycle power plant which includes a coal gasification plant is reported. Information is included on meetings held; completion of procurement procedures; gas turbine, compressors, blowers, and heat exchanger; specifications for heat recovery steam generators and auxiliary equipment; control systems; electrical equipment; and vessels. ERA

N78-21633# Brookhaven National Lab., Upton, N. Y.
ENERGY SYSTEMS ANALYSIS AND DEVELOPMENT
P. F. Palmedo 5 Jul. 1977 23 p refs Presented at Workshop on Systems Develop., Seoul, Rep. of Korea, 12-15 Jul. 1977
(Contract EY-76-C-02-0016)
(BNL-22969; Conf-770742-1) Avail: NTIS HC A02/MF A01

Systems analysis of energy problems, their technical and social complexity, and their long time scale is discussed in terms of formulating national energy policy. A number of models developed for such analysis are described. ERA

N78-21634# Brookhaven National Lab., Upton, N. Y.
PLANNER'S ENERGY WORKBOOK: A MANUAL FOR EXPLORING RELATIONSHIPS BETWEEN LAND USE AND ENERGY UTILIZATION
T. Owen Carroll, Robert Nathans, Philip F. Palemedo, and Robert Stern Jun. 1977 129 p refs Prepared in cooperation with State Univ. of New York, Stony Brook
(Contract EY-76-C-02-0016)
(BNL-50633) Avail: NTIS HC A07/MF A01

Procedures that were used to carry out community and regional energy analyses are described. The choice of land use activity parameters and their relations to energy use characteristics are associated with the normal planning concepts of land use density, type of residential development, commercial floorspace, industrial sales and employment, and shopping and work trip

lengths. Energy related intensity coefficient are expressed in a form that permits the analysis of short-term conservation strategies such as the retrofit of insulation and the introduction of new technologies such as solar energy. An integrating framework is provided to construct total community or area energy consumption profiles and future needs; to examine compatibility between area requirements and the energy supply-distribution system serving the area; and to evaluate the implications for energy use of the physical configuration of urban, suburban and rural areas. ERA

N78-21635# California Univ., Berkeley. Lawrence Berkeley Lab.

DISTRIBUTED TECHNOLOGIES IN CALIFORNIA'S ENERGY FUTURE: A PRELIMINARY REPORT, VOLUME 2

M. Christensen, ed., P. Craig, ed., C. B. McGuire, ed., and M. Simmons, ed. Sep. 1977 381 p refs

(Contract W-7405-eng-48)

(LBL-6831-Vol-2) Avail: NTIS HC A17/MF A01

Given a perspective that places environmental and social impacts at the heart of the energy predicament rather than on the periphery, it becomes essential to compare the impacts produced by alternative energy options systematically, comprehensively, and objectively. The information needed to do this properly, even for a limited set of technologies and a limited geographic and cultural contex (e.g., California), unfortunately does not exist. An attempt was made to outline a logical framework for such a comparison, and to hang on that framework the partial information that is available on the environmental impacts of some major conventional and nonconventional energy options for California. The objective was to permit at least some partial and preliminary conclusions about this aspect of the soft energy options, and to identify those areas where additional knowledge is most badly needed. Author

N78-21636# California Univ., Berkeley. Lawrence Berkeley Lab.

CATALYZED COMBUSTION IN A FLAT PLATE BOUNDARY LAYER. 1: EXPERIMENTAL MEASUREMENTS AND COMPARISON WITH NUMERICAL CALCULATIONS

R. Robben, R. Schefer, V. Agrawal, and I. Namer Sep. 1977 54 p refs Presented at Fall Meeting of the Western States Section of the Combustion Inst., Palo Alto, Calif., 17 Oct. 1977

(Contract W-7405-eng-48)

(LBL-6841; Conf-771015-6-1) Avail: NTIS HC A04/MF A01

Flow over a sharp leading edge flat plate was used to study the effect of a heated surface on combustion in lead hydrogen-air mixtures. The velocity and density profiles of the boundary layer were measured with laser Doppler velocimetry and Rayleigh scattering, respectively. Preliminary measurements on a silicon dioxide non-catalytic surface indicated neither boundary layer nor surface combustion for wall temperatures up to 1250 K. ERA

N78-21637# SRI International Corp., Menlo Park, Calif.

FUEL AND ENERGY PRICE FORECASTS: QUANTITIES AND LONG-TERM MARGINAL PRICES, VOLUME 1 Final Report

Sep. 1977 169 p

(EPRI Proj. 759-1)

(EPRI-EA-433-Vol-1) Avail: NTIS HC A08/MF A01

Forecasts of long-term marginal fuel and energy prices over the period 1985 to 2000 are shown in constant 1975 dollars on a regional basis for the United States. The major sources of energy analyzed are coal, uranium, crude oil, syncrude (produced from coal or oil shale), petroleum products, natural gas, and synthetic gas. Prices are shown at different levels of the energy system, e.g., from the point of production through consumption. Prices of delivered fuels are presented for four sectors: electric power generation, residential/commercial, industrial, and transportation. Because all fuels in the energy system are interrelated, the emphasis was to specify these relationships and to forecast prices (and quantities) at every level of the energy system. This was done within the framework of the SRI National Energy Model that explicitly models primary energy production and conversion, transportation and distribution, and end-use conversion. ERA

N78-21638# Minnesota Univ., Minneapolis.

GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM, EXECUTIVE SUMMARY, PHASE 1 Final Report, 1 Feb. - 31 May 1977

Jun. 1977 122 p

(Contract EC-77-C-02-4210)

(COO/4210-1-Summ) Avail: NTIS HC A06/MF A01

The community energy system focused on modifications to the central heating plant, wherein the capability of generating additional steam and by product electricity will be established by acquiring a retired generating plant. Adding on of community gas/oil committed loads to the coal fired system is examined and the installation of a pyrolysis system for the safe disposal of infections and hazardous waste whereby a low Btu gas will be generated is investigated. This will then be utilized in the plant as a supplement to its primary fuel requirements. The conversion of part of the steam distribution system to a variable flow and variable temperature hot water system is presented. ERA

N78-21639# City of Trenton, N. J. Dept. of Planning and Development.

TRENTON ICES, VOLUME 1, PHASE 1 Final Report

14 Jul. 1977 68 p

(Contract EC-77-C-02-4212)

(COO/4212-1/1-Vol-1) Avail: NTIS HC A04/MF A01

Phase 1 Preliminary Design and Evaluation for a Grid Connected Thermally Controlled Integrated Community Energy System (ICES) for Trenton, New Jersey has been carried out. The findings of the study are that: it is technically feasible, utilizing commercially available hardware; it is economically competitive with conventional alternatives for heating and cooling buildings; it will produce an overall reduction in fuel consumed of 32 to 43% when compared with conventional alternatives for heating and cooling buildings; it will consume 4 to 9% more oil than will conventional alternatives for heating and cooling buildings; it should be owned and operated by Public Service Electric and Gas Co. (PSE and G); and it can provide thermal energy 21 months after the start of Phase II and electrical energy 32 months after the start of Phase II. ERA

N78-21640# California State Dept. of Housing and Community Development, Sacramento.

CALIFORNIA RESIDENTIAL ENERGY STANDARDS: PROBLEMS AND RECOMMENDATIONS RELATING TO IMPLEMENTATION, ENFORCEMENT, DESIGN

Aug. 1977 373 p

(Contract EY-76-C-03-1178)

(SAN/1178-1) Avail: NTIS HC A16/MF A01

Documents relevant to the development and implementation of the California energy insulation standards for new residential buildings were evaluated and a survey was conducted to determine problems encountered in the implementation, enforcement, and design aspects of the standards. The impact of the standards on enforcement agencies, designers, builders and developers, manufacturers and suppliers, consumers, and the building process in general is summarized. The impact on construction costs and energy savings varies considerably because of the wide variation in prior insulation practices and climatic conditions in California. The report concludes with a series of recommendations covering all levels of government and the building process. ERA

N78-21641# De Laureal Engineers, Inc., New Orleans, La.

GRID-CONNECTED ICES PRELIMINARY FEASIBILITY ANALYSIS AND EVALUATION. VOLUME 1: EXECUTIVE SUMMARY Final Report

30 Jun. 1977 56 p Prepared in cooperation with Health Educ. Authority of La., New Orleans, New Orleans Public Serv., Inc., La. and Orr-Schelen-Maxeron and Associates, Inc., Minneapolis, Minn.

(Contract EC-77-C-02-4214)

(COO/4214-1/1-Vol-1) Avail: NTIS HC A04/MF A01

A group of hospitals, clinics, research facilities, and medical education facilities, was chosen as the site for the demonstration of a grid-connected integrated community energy system (ICES). The contract work included a preliminary energy supply/demand assessment of the demonstration community, a preliminary feasibility analysis and conceptual design of a candidate demonstration system, preliminary assessment of institutional factors, preparation of a detailed work management plan for subsequent

phases of the demonstration program, firming up of commitments from participating parties, and reporting thereon. ERA

N78-21642# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ENERGY ORIENTED STUDY OF INDUSTRIAL CYCLONE SEPARATORS
Neil D. Cox, Allan S. Richardson, and W. Paul Jensen Sep. 1977 40 p refs
(Contract EY-76-C-07-1570)
(TREE-1174) Avail: NTIS HC A03/MF A01

This study was conducted to obtain data for an estimate of the current and anticipated energy demand for the operation of industrial cyclone separators. The information sources used were technical papers and texts on the subject and a survey of manufacturers of cyclone separators. Estimates of the nationwide energy consumption of single gas cyclones, multiple tube gas cyclones, and liquid cyclones were obtained separately. These were added to obtain the total consumption for the three types. To this total was added an energy consumption estimate for the wet cyclone scrubbers manufactured by a single company. The final estimate of the gross annual energy consumption of cyclone devices is 0.38 exajoule (0.37 quad). ERA

N78-21643# Institute for Energy Analysis, Oak Ridge, Tenn.
THERMODYNAMICS AND ENERGY POLICY
R. M. Rotty and E. R. VanArtsdalen Jul. 1977 26 p refs
(Contract EY-76-C-05-0033)
(ORAU-IEA-M-77-18) Avail: NTIS HC A03/MF A01

Thermal efficiency was widely used in evaluating energy exchanges, but this procedure gave no consideration to quality of energy being used. Thermodynamics indicated that different energy quantities had different energy quality, and efficient use of energy required a matching of the energy quality supplied to that required for the given task. Thermodynamic efficiency as a figure of merit in evaluating energy exchanges had the advantage of considering energy quality. It did not give information to assist in the trade offs between resources and the other considerations that were made in the formulation of an energy policy. ERA

N78-21644# National Consumer Research Inst., Washington, D. C.
PROCEEDINGS OF THE ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION CONFERENCE ON COGENERATION AND INTEGRATED ENERGY/UTILITY SYSTEMS
1977 209 p refs Proc. held at Washington, D. C., 3 Jun. 1977 Prepared for Argonne National Lab.
(Contracts W-31-109-eng-38)
(CONF-770632) Avail: NTIS HC A10/MF A01

Cogeneration or integrated energy/utility systems have established their place in contributing energy supply in major cities throughout the United States. Cogeneration has been primarily associated with industrial processes, while integrated energy systems have been primarily associated with residential and commercial applications or with district heating of large metropolitan areas. The conference was conceived to bring the two ideas together as much as technically and economically possible. An attempt was made to broaden the scope and integrate the two concepts establishing a very workable basis for the utilization of both in the performance of providing utility services to industrial applications and population centers. The resurgence of cogeneration evolves through the efforts to maximize the use of resources in the United States today. This forum, brought together some of the most prominent individuals associated with the concepts of cogeneration, community energy systems, and integrated utility systems. Author (ERA)

N78-21645# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
SOLAR SPACE HEATING SYSTEMS USING ANNUAL HEAT STORAGE Progress Report, 1 Jul. - 31 Dec. 1976
F. C. Hooper and C. R. Attwater Apr. 1977 99 p
(Contract EY-76-C-02-2939)
(COO/2939-1) Avail: NTIS HC A05/MF A01

The assumptions made in the development of the computer simulation used for modeling annual storage solar heating systems are outlined. A vertical cylindrical storage tank was used with homogeneous soil properties and a water table and ground surface acting as sinks. The equations are described in a general way. ERA

N78-21646# Delaware Univ., Newark. Inst. of Energy Conversion.
IMPROVED SEMICONDUCTORS FOR PHOTOVOLTAIC SOLAR CELLS Quarterly Report, 1 Oct. - 31 Dec. 1976
D. Brindle, A. W. Catalano, J. Cambridge, V. Dalal, V. Dalton, E. A. Fagen, F. Gribbin, R. B. Hall, J. D. Meakin, and G. Warfield Oct. 1977 53 p refs
(Contract EX-76-C-01-2460)
(DSE/2460-2) Avail: NTIS HC A04/MF A01

The Zn3P2 is now being synthesized routinely from pure zinc and phosphorous. Work has continued on the preparation of thin films by physical vapor deposition using only IEC synthesized starting material. The influence of growth parameters such as growth rate, source and substrate temperatures on film structure, resistivity and optical absorption were investigated. No significant correlation of structural, electrical or optical properties of the films was found with growth rate over the range 0.3 to 2.0 microgram/sq cm-sec. ERA

N78-21647# Oak Ridge National Lab., Tenn.
ANNUAL CYCLE ENERGY SYSTEM CONCEPT AND APPLICATION
John C. Moyers and Eugene C. Hise 1977 8 p refs Presented at Faculty Inst. Energy Conserv.: Theory and Practice, Oak Ridge, Tenn., 1 Aug. 1977
(Contract W-7405-eng-26)
(CONF-770870-1) Avail: NTIS HC A02/MF A01

The Annual Cycle Energy System (ACES), under development at ERDA's Oak Ridge National Laboratory, promises to provide space heating, air conditioning, and water heating at a significantly lower expenditure of energy than conventional space conditioning and water heating systems. The ACES embodies heat pumping, thermal storage and, where climate dictates, solar assistance. The concept is described, along with variations in design that permit flexibility to maximize energy conservation or to provide load management capabilities. Installations that exist or are under construction are described and variations that are incorporated to meet specific objectives are discussed. ERA

N78-21648# Oak Ridge National Lab., Tenn.
CONSERVATION AND THE CONTRIBUTIONS FROM ADVANCED ENERGY SOURCE
S. E. Beall, Jr. 1977 31 p Presented at Faculty Inst. Energy Conserv.: Theory and Practice, Oak Ridge, Tenn., 2 Aug. 1977
(Contract W-7405-eng-26)
(CONF-770870-2) Avail: NTIS HC A03/MF A01

Advanced energy sources being developed by ERDA are discussed, along with contribution of 1 Q (quadrillion Btu) or less in 1985, and estimates perhaps optimistically that these new technologies can contribute as much as 25 Q of our energy needs by 2000 A.D. ERA

N78-21649# Battelle Pacific Northwest Labs., Richland, Wash.
GEOTHERMAL ENERGY POTENTIAL FOR DISTRICT AND PROCESS HEATING APPLICATIONS IN THE US: AN ECONOMIC ANALYSIS
C. H. Bloomster, L. L. Fassbender, and C. L. McDonald Aug. 1977 61 p refs
(Contract EY-76-C-06-1830)
(BNWL-2311) Avail: NTIS HC A04/MF A01

Geothermal energy is competitive for space and process heating applications over significant distances when employed on a large scale to serve concentrated markets. Under these conditions geothermal energy from 90 to 150 C hydrothermal resources should be economically competitive for high density urban district heating out to distances of 50 miles from the wellhead. Supply curves (price-quantity relationships) were developed for both process heating and district heating applications for distances out to 50 miles. The 90 to 150 C hydrothermal resources, which were identified in the assessment of geothermal resources by the U.S. Geological Survey, contain usable energy for space and process heat equivalent to 50 billion barrels of oil. The potential demand for space and process heat near these

hydrothermal resources is large; over 10% of the U.S. population resides within 40 miles of the resources. ERA

N78-21650# Bechtel Corp., San Francisco, Calif.
DEFINITION OF REQUIREMENTS FOR GEOTHERMAL POWER CONVERSION SYSTEM STUDIES
30 Jun. 1977 45 p refs
(Contract W-7405-eng-48)
(UCRL-13751) Avail: NTIS HC A03/MF A01

Candidate power conversion systems and criteria for comparing these systems are listed. The elements of each conceptual design and standard approaches to equipment design are described. The methods used to calculate heat and mass balances and the data used in the calculations are described. The method used in developing the economics of each system is described and factors such as construction wage rates common to all systems are included. Standard methods for developing the conceptual designs and corresponding economics are defined so that the results of each system study can be readily compared to those of the others. The candidate conversion systems are: multistage flash/binary; two stage flash with scrubbing; total flow; multistage flash/direct contact (Bechtel patented process); four stage flash/binary; binary with direct contact heat exchangers; hybrid-flash/binary; hybrid-flash/total flow; and flash/dual cycle binary. ERA

N78-21651# General Electric Co., Schenectady, N. Y. Corporate Research and Development Div.
STUDY OF PRACTICAL CYCLES FOR GEOTHERMAL POWER PLANTS Final Report, 15 Jun. 1975 - 15 Mar. 1977
J. H. Eskesen Apr. 1977 160 p refs
(Contract EY-76-C-02-2619)
(COO-2619-1) Avail: NTIS HC A08/MF A01

A comparison was made of the performance and cost of geothermal power cycles designed specifically, utilizing existing technology, to exploit the high temperature, high salinity resource at Niland and the moderate temperature, moderately saline resource at East Mesa in California's Imperial Valley. Only two kinds of cycles were considered in the analysis. Both employed a dual flash arrangement and the liberated steam was either utilized directly in a condensing steam turbine or used to heat a secondary working fluid in a closed Rankine (binary) cycle. The performance of several organic fluids was investigated for the closed cycle and the most promising were selected for detailed analysis with the given resource conditions. Results showed for the temperature range that if the noncondensible gas content in the brine was low, a dual flash condensing steam turbine cycle was potentially better in terms of resource utilization than a dual flash binary cycle. ERA

N78-21652# Institute for Energy Analysis, Oak Ridge, Tenn.
NET ENERGY ANALYSIS OF AN OCEAN THERMAL ENERGY CONVERSION (OTEC) SYSTEM
A. M. Perry, G. Marland, and L. W. Zelby Feb. 1977 55 p refs
(Contract EY-76-C-05-0033)
(ORAU/IEA(M)-77-1) Avail: NTIS HC A04/MF A01

The system used a Rankine power cycle with ammonia as the working fluid, and was based on essentially available technology. The plant would be located about 20 miles offshore and would produce 160 MW(e) of net electricity which would be carried ashore by underwater cable for transmission and distribution by conventional means. Evaporators and condensers for the ammonia power cycle were assumed to be made of titanium (for resistance to corrosion) although it was recognized that aluminum alloys-preferable from a cost standpoint-would prove to have acceptable corrosion resistance. Net electrical output of the plant at an assumed 90% plant factor was 1.26 x 10 to the 9th kWh(e) per year. ERA

N78-21653# Institute for Energy Analysis, Oak Ridge, Tenn.
NET ENERGY FROM MUNICIPAL SOLID WASTE
Ned L. Treat Feb. 1977 42 p refs
(Contract EY-76-C-05-0033)
(ORAU/IEA(M)-77-5) Avail: NTIS HC A03/MF A01

Technologies for producing energy from municipal solid waste are compared. The system that produced solid fuel and used it as a supplemental fuel at an existing coal burning steam plant is used as a surrogate system. A description of each of the components of this system is given. An analysis of the expenditures and the energy savings for each component is made. The ratio of energy savings for the entire system is found to be approximately 9 percent. ERA

N78-21654# Energy Task Force, Inc., New York.
WINDMILL POWER FOR CITY PEOPLE Final Report
Mary Christianson May 1977 73 p
(Grant CSA-20156)
(PB-275658/3; OEO-LN-2137) Avail: NTIS HC A04/MF A01 CSCL 10B

Findings show that the energy produced from the windmill is an important renewable energy resource which can be used in most urban areas and which reduces dependency on utility companies. A brief history of the windmill's origin, design and installation procedures are outlined. Also included are comparisons of energy savings of the windmill energy versus the utility companies. An appendix consists of literature, resources, a wind speed and direction map, structural engineering calculations and an explanation of windforces on windmills. GRA

N78-21655# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
ANALYSIS OF DATA AND RESULTS FOR THE ROUND-ROBIN FLAT-PLATE COLLECTOR TEST PROGRAM Final Report
W. C. Thomas and A. G. Dawson 14 Dec. 1977 87 p refs Revised Sponsored by NBS
(PB-275576/7; VPI-SU-ENG-77-23-Rev;
NBS/GCR-77-109-Rev) Avail: NTIS HC A05/MF A01 CSCL 10A

A roundrobin test program was conducted to evaluate a proposed method for rating solar collectors with respect to thermal performance. The approach used was to reference the measured results to a common set of environmental and operating conditions using thermal performance theory. Environmental conditions were wind speed, ambient temperature, and the amount and structure of solar radiation. Operating conditions considered were the transfer fluid (composition and flow rate) and collector orientation. GRA

N78-21656# Washington Center for Metropolitan Studies, Washington, D. C.
COLDER - DARKER: THE ENERGY CRISIS AND LOW-INCOME AMERICANS; AN ANALYSIS OF IMPACT AND OPTIONS
Eunice S. Grier Jun. 1977 88 p refs
(Contract CSA-B6B-5522)
(PB-275656/7; OEO-LN-2138) Avail: NTIS HC A05/MF A01 CSCL 10A

Personal interviews of a representative sample of U.S. households are presented, with data on consumption and costs obtained directly from their utility suppliers. An analysis of the information from both surveys, and an assessment of the impact of the energy situation on the lives of poor Americans are given. GRA

N78-21657# State Univ. of New York, Albany. Atmospheric Sciences Research Center.
ENERGY CONSERVATION VIA SOLAR ENERGY APPLICATIONS TO MULTI-FAMILY AND COMMERCIAL STRUCTURES. VOLUME 3: AN ENERGY, ENGINEERING AND ECONOMIC ANALYSIS OF HEATING AND COOLING SYSTEMS FOR MULTI-FAMILY STRUCTURES
William S. Fleming, Thomas Bender, Thaddeus Jagusztyn, Phillip Parkman, and Donald Sweetser 7 Sep. 1977 107 p refs Sponsored in part by New York State Energy Research and Development Authority
(PB-276131/0; ASRC-SUNY-PUB-420; NYSERDAi75/126) Avail: NTIS HC A06/MF A01 CSCL 13A

An energy analysis was made for a multi family apartment model involving the heating, cooling, lumination and miscellaneous equipments energy consumption. The analysis compared various heating, ventilating and air conditioning systems with and without solar assistance to determine their merits on the basis of energy conservation and economic value. An electric resistance heating

and electric air conditioning system were utilized as the basis for system comparison. The buildings orientation, U value and infiltration were also analyzed for consideration of architectural variables. GRA

N78-21658# Transport and Road Research Lab., Crowthorne (England).
EVALUATION OF NOISE NUISANCE: A STUDY OF WILLINGNESS TO RECEIVE PAYMENT FOR NOISE INTRODUCED INTO THE HOME
S. P. C. Plowden (Metra Consulting Group, London) and P. R. J. Sinnott (Metra Consulting Group, London) 1977 51 p refs (PB-276418/1; TRRL-Supplementary-261; ISSN-0305-1315) Avail: NTIS HC A04/MF A01 CSCL 13B

The basic idea behind these studies, originally put forward, was to offer people a payment to have a noise machine in their home for a fixed period of time in order to assess the compensation required to make them as satisfied after the imposition of a noise nuisance as they were before. A method was developed of relaying tape recorded traffic noise by adapting a commercial background system. In the first phase of the second contract the machine was developed to relay noise in all the rooms of the house. In the second the sample was divided into four groups which were offered either a one room or a whole-house installation. GRA

N78-21659# Bureau of the Census, Washington, D. C.
ANNUAL SURVEY OF MANUFACTURES, 1975. FUELS AND ELECTRIC ENERGY CONSUMED. STATISTICS FOR THE UNITED STATES
Sep. 1977 259 p
(PB-275772/2; M75(AS)-4) Avail: NTIS MF A01; HC avail: Subscriber Services Section (Publications), Bureau of the Census, Washington, D. C. 20233 CSCL 10A

Data are shown on the total cost of fuels, quantity and cost of electric energy purchased for use and quantity of electric energy generated and used in manufacturing plants. Revisions of 1974 quantity and cost of distillate and residual fuel oil statistics for the United States, regions, and states are included. GRA

N78-21660# Ernst and Ernst, Washington, D. C.
THE LONG-RUN INCREMENTAL COST OF ELECTRIC UTILITIES Final Draft Report
Oct. 1977 214 p ref
(Grant NSF APR-75-166666)
(PB-276082/5; NSF/RA-770335) Avail: NTIS HC A10/MF A01 CSCL 10B

Three methods for determining the marginal cost of electricity generation, transmission, and distribution were evaluated. A description of the model developed during this project and the test results are included. A production function was estimated and a longrun total cost equation was derived by minimizing cost subject to the production function and required outputs. The total cost function was then differentiated to arrive at the marginal costs. GRA

N78-21661# Mitre Corp., McLean, Va. METREK Div.
ALASKAN OIL TRANSPORTATION ISSUES
Richard Brown Oct. 1977 17 p refs
(Contract EPA-68-01-3188)
(PB-276449/6; EPA-600/9-77-019) Avail: NTIS HC A02/MF A01 CSCL 10A

The transport and distribution of Alaskan oil poses serious problems with respect to potential impacts upon the quality of air, water, and land, especially in the western United States. The history and problems associated with assuring environmental compatibility in the disposition of Alaskan oil reserves is presented. GRA

N78-21662# Atomic Energy Organization of Iran, Teheran. Reactor Technology Section.
STUDY OF SOME RECENT ADVANCES IN THE CONCEPT AND DESIGN OF MHD GENERATORS
M. Vakilian Feb. 1976 19 p refs
(AEOI-26; NRC-76-20) Avail: NTIS (US Sales Only) HC A02/MF A01; ERDA Depository Libraries

Direct conversion of energy using a high temperature working fluid makes magnetohydrodynamics (MHD) power plants potentially much more efficient than steam power stations. The study indicated an overall efficiency of 50 percent to 60 percent. This compared with most modern fossil-fuel plants at 40 percent efficiency. Advances in design and construction of experimental and commercial MHD plants developed in various countries are presented. Environmental effects and advantages of the MHD power plants over the more conventional fossil and nuclear plants are discussed. ERA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N78-21663 Virginia Polytechnic Inst. and State Univ., Blacksburg.
AIR POLLUTION MODELING Ph.D. Thesis
Byron Craig Lewis 1977 360 p
Avail: Univ. Microfilms Order No. 7801593

Air pollution models are presented which address themselves to the specific problems of pinpointing locations of relative maxima, producing air quality maps efficiently, and presenting graphic representation of patterns of pollution over a mesoscale region. MAXPOL-A is a semiempirical, source oriented, microscale deterministic, climatological air pollution model which used a simplex search algorithm to walk, one step at a time, toward the area of maximum concentration. Input parameters governed the length of walk and the precision with which the maximum was located. SIMPLOT is a semiempirical, source oriented, stochastic, climatological air pollution model and employed the concept of stochastic simulation as well as simulation in the usual sense to obtain estimates of air quality. SIMPLOT also used a technique called the plume projection procedure which allowed it to generate all of the receptors. Dissert. Abstr.

N78-21664*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ASSESSMENT OF AN F2 OR N2O4 ATMOSPHERIC INJECTION FROM AN ABORTED SPACE SHUTTLE MISSION
R. T. Watson, P. E. Smokler, and W. B. DeMore 15 Apr. 1978 49 p refs
(Contract NAS7-100)
(NASA-CR-156164; JPL-Pub-77-81) Avail: NTIS HC A03/MF A01 CSCL 13B

Assuming a linear relationship between the stratosphere loading of NOx and the magnitude of the ozone perturbation, the change in ozone expected to result from space shuttle ejection of N2O4 was calculated based on the ozone change that is predicted for the (much greater) NOx input that would accompany large-scale operations of SSTs. Stratospheric fluorine reactions were critically reviewed to evaluate the magnitude of fluorine induced ozone destruction relative to the reduction that would be caused by addition of an equal amount of chlorine. The predicted effect on stratospheric ozone is vanishingly small. Author

N78-21665*# IIT Research Inst., Chicago, Ill.
ATMOSPHERIC SCAVENGING OF SOLID ROCKET EXHAUST EFFLUENTS Final Report
Donald L. Fenton and Robert Purcell Apr. 1978 84 p refs
(Contract NAS8-31947)
(NASA-CR-2997; M-251) Avail: NTIS HC A05/MF A01 CSCL 13B

Solid propellant rocket exhaust was directly utilized to ascertain raindrop scavenging rates for hydrogen chloride. Two chambers were used to conduct the experiments; a large, rigid walled, spherical chamber stored the exhaust constituents, while the smaller chamber housing all the experiments was charged as required with rocket exhaust HCl. Surface uptake experiments demonstrated an HCl concentration dependence for distilled water. Sea water and brackish water HCl uptake was below the detection limit of the chlorine-ion analysis technique used. Plant life HCl uptake experiments were limited to corn and soybeans. Plant age effectively correlated the HCl uptake data. Metallic corrosion was not significant for single 20 minute exposures to the exhaust HCl under varying relative humidity. Characterization of the aluminum oxide particles substantiated the similarity between

the constituents of the small scale rocket and the full size vehicles. Author

N78-21666# Little (Arthur D.), Inc., Cambridge, Mass.
THEORETICAL STUDY TO DETERMINE THE SEA STATE LIMIT FOR THE SURVIVAL OF OIL SLICKS ON THE OCEAN Final Report
Phani P. K. Raj Jun. 1977 276 p refs
(Contract DOT-CG-61505-A)
(AD-A049794; ADL-79299-F; USCG-D-90-77) Avail: NTIS HC A13/MF A01 CSCL 06/6

Limiting sea state condition for the globular dispersion of oil slicks on the ocean have been obtained from simple considerations. Models have been derived for determining the conditions under which breaking waves will disperse an oil slick. Two types of dispersions are considered, viz., surface dispersion and globular dispersion within the water column, with emphasis on the latter type of dispersion. The results indicate that a 3 m significant wave height sea state will tend to initiate globular dispersion and that breaking waves of large crest lengths are essential for a surface dispersion to take place. The depth of penetration of globules of oil formed under breaking waves is calculated to be relatively shallow. The large number of assumptions made and their effects on the results are discussed. Several of the unknown physical parameters of importance are identified and recommendations have been made for experimental determination of some of these parameters. Author (GRA)

N78-21667# GCA Corp., Bedford, Mass. GCA Technology Div.
FILTRATION MODEL FOR COAL FLY ASH WITH GLASS FABRICS Final Task Report, Jun. 1974 - Jun. 1977
Richard Dennis, R. W. Cass, D. W. Cooper, R. R. Hall, and Vladimir Hampl Aug. 1977 490 p refs
(Contract EPA-68-02-1438)
(PB-276489/2; GCA-TR-75-17-G; EPA-600/7-77-084) Avail: NTIS HC A21/MF A01 CSCL 13K

An extensive bench and pilot scale laboratory investigation of several dust/fabric combinations were studied. Also included were field data from three prior GCA studies involving coal fly ash filtration with glass fabrics and past GCA studies of fabric filter cleaning mechanisms. The introduction and experimental confirmation of two basic concepts were instrumental in model design: one relates to the way dust dislodges from a fabric and its subsequent impact upon resistance and penetration in a multichambered system; the other, to the relatively large fly ash fractions that pass with minimal collection through temporarily or permanently unblocked pores or pinholes. GRA

N78-21668# Southern Research Inst., Birmingham, Ala.
INERTIAL CASCADE IMPACTOR SUBSTRATE MEDIA FOR FLUE GAS SAMPLING Final Report, Nov. 1976 - Mar. 1977
Larry G. Felix, George I. Clinard, George E. Lacey, and Joseph D. McCain Jun. 1977 92 p
(Contract EPA-68-02-2131)
(PB-276583/2; EPA-600/7-77-060) Avail: NTIS HC A05/MF A01 CSCL 13B

Available greases and glass fiber filter media were tested to determine which were most suitable for flue gas sampling. Of 19 greases tested by heating in the laboratory and by exposure to flue gas in the field, only Apiezon H grease performed satisfactorily at above 149 C. In experiments to evaluate the use of filter materials as impactor substrates, mass increased as a result of exposure to flue gas for all of the fiber media tested. Laboratory and field studies were described which were directed toward developing a method of passivate glass fiber filter material to SOx induced mass gains. Reeve Angel 934AH glass fiber filter material performed best among the media tested. GRA

N78-21669# Energy, Inc., Idaho Falls, Idaho.
ENERGY SUPPLY AND ENVIRONMENTAL IMPACTS: CONVENTIONAL ENERGY SOURCES Final Report
James McFadden 1977 349 p Sponsored in part by Northwest Energy Policy Project, Portland, Oreg. and by Pacific Northwest Regional Commission, Vancouver, Wash.
(PB-276410/8; NEPP-III-A) Avail: NTIS HC A15/MF A01 CSCL 10A

The future supplies and prices of all forms of energy consumed in the Pacific Northwest (electricity, natural gas, petroleum, and coal) through the year 2000 are examined. Sets of alternative assumptions on the availability, price and use of these forms of energy are used to develop scenarios leading to low, moderate, and high rates of growth in supply and demand. Quantified estimates of the environmental impacts likely to occur at each rate of growth are given. GRA

N78-21670# Tennessee Valley Authority, Muscle Shoals, Ala. Office of Agricultural and Chemical Development.
TECHNICAL ASSESSMENT OF NOx REMOVAL PROCESSES FOR UTILITY APPLICATION Final Report, Oct. 1976 - Jul. 1977
H. L. Faucett, J. D. Maxwell, and T. A. Burnett Nov. 1977 429 p refs Sponsored by EPA, Research Triangle Park, N. C.
(PB-276637/6; TVA-Y-120; EPA-600/7-77-127) Avail: NTIS HC A19/MF A01 CSCL 07A

Results are presented of processes being developed to remove NOx from power plant stack gas. Processes include wet and dry NOx processes, and wet and dry simultaneous NOx/SOx processes. Each process technical evaluation included a detailed description, a simplified block flow diagram, its current development status, its raw material and utility requirements, published economics, technical and environmental considerations, and its overall advantages and disadvantages. GRA

N78-21671# Battelle Pacific Northwest Labs., Richland, Wash.
DESCRIPTION AND COMPARISON OF ENERGY IMPACT ASSESSMENT MODELS
R. A. Burnett and D. W. Fraley Apr. 1977 96 p refs
(Contract EY-76-C-06-1830)
(BNWL-2107) Avail: NTIS HC A05/MF A01

During the past few years the need for more comprehensive analytical techniques for assessing the environmental, economic, and social impacts of energy supply-demand systems and related public policy-making activities has increased. The research and academic communities have responded to this need by developing a wide range of models and other analytical tools for energy impact estimation. The models generally fall into two categories: large-scale and specialized. This report examines the general features and shortcomings of current large-scale and specialized modeling efforts from the point of view of energy impact assessment. Characteristics deemed desirable in large-scale energy-impact-assessment models and related studies are discussed. An outline of criteria for describing and comparing such models is presented, from which seven large-scale energy models and one impact-assessment study are described and compared in considerable detail. Tables are also presented which summarize the results of the categorizations. ERA

N78-21672# SRI International Corp., Menlo Park, Calif.
THE RELATION OF OXIDANT LEVELS TO PRECURSOR EMISSIONS AND METEOROLOGICAL FEATURES. VOLUME 2: REVIEW OF AVAILABLE RESEARCH RESULTS AND MONITORING DATA, AS OF NOVEMBER 1975 Final Report
H. B. Singh, W. B. Johnson, and E. Reiter (Colorado State Univ.) Sep. 1977 125 p refs
(Contract EPA-68-02-2084; SRI Proj. 4432)
(PB-275326/7; EPA-450/3-77-022b-Vol-2) Avail: NTIS HC A06/MF A01 CSCL 04A

Literature was reviewed and a summary was prepared describing the processes affecting ozone concentrations in remote areas. The topics discussed include ozone of stratospheric origin, natural tropospheric sources and sinks, and long range transport in the troposphere. GRA

N78-21673# SRI International Corp., Menlo Park, Calif.
THE RELATION OF OXIDANT LEVELS TO PRECURSOR EMISSIONS AND METEOROLOGICAL FEATURES. VOLUME 3: APPENDICES (ANALYTICAL METHODS AND SUPPLEMENTARY DATA) Final Report
F. L. Ludwig, P. B. Simmon, R. L. Mancuso, J. H. S. Kealoha, and E. Reiter (Colorado State Univ.) Sep. 1977 415 p refs
(Contract EPA-68-02-2084; SRI Proj. 4432)
(PB-275327/5; EPA-450/3-77-022c-Vol-3) Avail: NTIS HC A18/MF A01 CSCL 04A

Contents include data selection and methodology for trajectory

analysis; meteorological and emission index computer program; computation of Montgomery stream functions; and daily weather and peak hour ozone maps for 1974. GRA

N78-21674# National Training and Operational Technology Center, Cincinnati, Ohio.
EFFLUENT MONITORING PROCEDURES: METALS ANALYSES. STUDENT REFERENCE MANUAL
Paul Hallbach Dec. 1977 200 p
(PB-275391/1; EPA-430/1-77-010) Avail: NTIS HC A09/MF A01 CSCL 07D

The training course manual was designed for wastewater treatment plant technicians who will be responsible for performing selected metals analyses in treatment plant effluents. The manual contains procedures for selected analyses, including boron, copper, ion, mercury, sodium, and zinc. GRA

N78-21675# National Training and Operational Technology Center, Cincinnati, Ohio.
EFFLUENT MONITORING PROCEDURES: METALS ANALYSES. STAFF GUIDE FOR CONDUCTING THE COURSE
Paul Hallbach Dec. 1977 138 p
(PB-275393/7; EPA-430/1-77-006) Avail: NTIS HC A07/MF A01 CSCL 07D

The staff guide was designed to be used by instructors to assist in the conduct of the course. The manual contains course planning and management information, including course plan and working schedules, training resources, secretarial support, and instructional package worksheets. GRA

N78-21676# California State Dept. of Transportation, Sacramento. Transportation Lab.
CALINE 2: AN IMPROVED MICROSCALE MODEL FOR THE DISPERSION OF AIR POLLUTANTS FROM A LINE SOURCE Interim Report
C. E. Ward, Jr., A. J. Ranzieri, and E. C. Shirley Jun. 1977 111 p refs
(Contract DOT-FH-11-7730)
(PB-275683/1; CA-DOT-TL-7218-1-76-23; FHWA/RD-77-74) Avail: NTIS HC A06/MF A01 CSCL 13B

CALINE 2 is based on the generalized Gaussian dispersion theory, and simulates the dispersion of carbon monoxide from a uniform line source. A sensitivity analysis of the model related the behavior of its predictions as a function of the input parameters. A preliminary verification study using carbon monoxide data from the Los Angeles region gives the user an estimate of CALINE 2's predictive capabilities. GRA

N78-21677# Acurex Corp., Mountain View, Calif. Aerotherm Div.
PRELIMINARY ENVIRONMENTAL ASSESSMENT OF COMBUSTION MODIFICATION TECHNIQUES. VOLUME 1: SUMMARY Special Report, Jun. 1976 - Feb. 1977
H. B. Mason, A. B. Shimizu, J. E. Ferrell, G. G. Poe, L. R. Waterland, and R. M. Evans Oct. 1977 76 p refs
(Contract EPA-68-02-2160)
(PB-276680/6; EPA-600/7-77-119a-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 21B

Equipment characterizations and multimedia emission inventories are presented for utility and industrial boilers, commercial and residential warm air furnaces, gas turbines, IC engines, industrial processes, and advanced combustion processes. Control costs and operational, energy, and environmental impacts are compiled and discussed for current and emerging combustion modification NOx controls. Significant data gaps in emission and impacts of multimedia pollutants, with and without NOx controls, are noted. Program priorities for field tests and process studies to augment the data base are presented. GRA

N78-21678# Acurex Corp., Mountain View, Calif. Aerotherm Div.
PRELIMINARY ENVIRONMENTAL ASSESSMENT OF COMBUSTION MODIFICATION TECHNIQUES. VOLUME 2: TECHNICAL RESULTS Special Report, Jun. 1976 - Feb. 1977
H. B. Mason, A. B. Shimizu, J. E. Ferrell, G. G. Poe, L. R. Waterland, and R. M. Evans Oct. 1977 581 p refs
(Contract EPA-68-02-2160)
(PB-276681/4; EPA-600/7-77-119b-Vol-2) Avail: NTIS HC A25/MF A01 CSCL 21B
For abstract, see N78-21677.

N78-21679# Environmental Sciences Research Lab., Research Triangle Park, N.C.
INTERNATIONAL CONFERENCE ON OXIDANTS, 1976: ANALYSIS OF EVIDENCE AND VIEWPOINTS. PART 1: DEFINITION OF KEY ISSUES
Basil Dimitriades and A. Paul Altshuller Oct. 1977 39 p refs
(PB-276768/9; EPA-600/3-77-113) Avail: NTIS HC A03/MF A01 CSCL 04A

The more than one hundred presentations and discussions at the conference revealed the existence of several issues and prompted the EPA to sponsor a follow-up review/analysis effort. The follow-up effort was designed to review carefully and impartially, to analyze relevant evidence and viewpoints reported at the international conference, and to attempt to resolve some of the oxidant-related scientific issues. The review/analysis was conducted by experts of widely recognized competence and experience in the area of photochemical pollution occurrence and control. GRA

N78-21680# Meteorology Research, Inc., Altadena, Calif.
CENTURY INDUSTRIAL PRODUCTS FRP-100 WET SCRUBBER EVALUATION Final Task Report, Aug. 1976 - Aug. 1977
D. S. Ensor and R. G. Hooper Oct. 1977 69 p refs
(Contract EPA-68-02-2125)
(PB-276520/4; MR176-FR-1468; EPA-600/7-77-116) Avail: NTIS HC A04/MF A01 CSCL 07A

The performance of a wet scrubber installed on a lightweight aggregate kiln was evaluated. Inlet/outlet tests for particle size distribution with cascade impactors and extractive sampling with an electrical aerosol size analyzer, and plume opacity with a plant process visiometer were conducted. The scrubber, operating at 80% rated capacity, had an aerodynamic cut diameter of 0.8 microns at a theoretical hydraulic power of 15.8 watts/a cu m/min. The liquid-to-gas ratio was about 2.161/cu m. The formation of submicron aerosol from the evaporation in the gas cooling section of water containing dissolved solids was observed during all tests. GRA

N78-21681# Southampton Univ. (England). Inst. of Sound and Vibration Research.
REVIEW OF DIESEL COMBUSTION MODELS FOR NOx AND SMOKE EMISSIONS Final Report, Jun. - Nov. 1976
David Anderton Oct. 1977 156 p refs
(Contract DOT-TSC-1101)
(PB-276350/6; DOT-TSC-OST-76-57) Avail: NTIS HC A08/MF A01 CSCL 13B

A comprehensive review of diesel emissions models is presented together with assessments of the pertinent fundamental NOx and soot kinetics. The results of diesel emissions experiments are also presented and correlations are suggested. Suggestions are made for model development, fundamental data acquisition and the use of incylinder experimental techniques. The latter were required to obtain data on the flowfield and mixing processes occurring in the diesel combustion chamber. GRA

N78-21682# Air Pollution Technology, Inc., San Diego, Calif.
AMERICAN AIR FILTER KINPACTOR 10 X 56 VENTURI SCRUBBER EVALUATION Final Report, Aug. 1976 - Oct. 1977
Seymour Calvert, Harry Barbarika, and Gary M. Monahan Nov. 1977 57 p ref
(Contract EPA-68-02-1869)
(PB-276716/8; EPA-600/2-77-209b) Avail: NTIS HC A04/MF A01 CSCL 97A

Average total efficiency was 97.5% during the test period. The venturi was operated at a pressure drop of 110 cm W. C., using about 33 liters/s of scrubbing liquor for a gas flow rate of about 20 A cu m/s at 80 C. The dust had a mass median aerodynamic diameter of about 0.8 micrometers A. The collection efficiencies of particles with aerodynamic diameters between 0.3 and 3 micrometers A were determined from size distribution data taken with cascade impactors. The efficiency data showed

the venturi to be more efficient than predicted for particle sized below 1 micrometer A. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N78-21683 Columbia Univ., New York.
A GEOPHYSICAL INVESTIGATION OF THE OCEANOGRAPHER FRACTURE ZONE AND THE MID-ATLANTIC RIDGE IN THE VICINITY OF 35 DEG NORTH Ph.D. Thesis
Frederick William Schroeder 1977 471 p
Avail: Univ. Microfilms Order No. 78-02311

Bathymetric studies of the survey area have resulted in several observations. The average trend of the oceanographer transform is a composite of two trends: a N 74 deg W trend near the center of the transform; and a N 88 deg E trend evident near both ridge transform intersections. The N 88 deg E trending segments are compatible with most kinematic models of North American-African plate motion. The N 74 deg W trend is compatible with the previous pole of rotation and thus appears to be a fossil trend. Furthermore, the bathymetric data indicated that the proximity of transform faults is significant in controlling the morphology of the accreting plate boundary. Several morphologic parameters, such as the depth of the valley and the width of the rift valley, systematically vary away from the rift valley-transform intersections for distances of at least 40 km. Finally, the bathymetric data indicate that there were two major changes in plate motion during the Cenozoic.
Dissert. Abstr.

N78-21684 Stanford Univ., Calif.
EARTHFLOW Ph.D. Thesis
David Knight Keefer 1977 393 p
Avail: Univ. Microfilms Order No. 78-02180

Studies led to several insights into mechanisms of earthflow movement. The initiation of movement was explained by the slope stability analysis of soil mechanics which took into account the effects of pore water pressure, shear strength, geometry, and unit weight. Earthflows were mobilized following heavy rainstorms. Water infiltrated into the ground and formed local, perched water tables. These caused pore water pressures to rise, and when the pressures exceeded critical levels, earthflow movements began. Movements continued until pore water pressures were decreased by drainage or evaporation. The initiation of movement was accompanied by an increase in water content which brought the soil to a state of near saturation and by a marked softening of the soil which was due to the dissipation of negative pore water pressures. Most movements took place by boundary slip, and only minor internal deformation occurred.
Dissert. Abstr.

N78-21685 Maryland Univ., College Park.
CRUSTAL EVOLUTION IN THE EARLY EARTH: BASIN-FORMING IMPACTS, CRUSTAL DICHOTOMY, AND PLATE TECTONICS Ph.D. Thesis
Herbert VanDyke Frey 1977 233 p
Avail: Univ. Microfilms Order No. 7800391

The origin of the earth's fundamental crustal dichotomy of high density/low density crust, the onset of plate tectonic processes on the earth, and the influence of major basin forming impacts on the early development of the earth's crust were studied. The results indicate: a high density/low density crustal dichotomy was established early in the history of the earth as a result of some 50% of the earth's original global crust being converted to low-lying topography by basin forming impacts. These low-lying regions were rapidly flooded by basaltic lavas derived by partial melting associated with the pressure drop of impact excavation. The earth's original crustal dichotomy was a mare/highland dichotomy superficially similar to that of the moon. Thinning of the lithosphere and steepening of the thermal gradients by basin formation made the sub basin lithosphere particularly susceptible to rifting and breakup into plate like structures.
Dissert. Abstr.

N78-21686 California Univ., San Diego.
CONDUCTIVITY OF THE OCEAN CRUST Ph.D. Thesis
Pavel Pistek 1977 116 p
Avail: Univ. Microfilms Order No. 7732829

The effects of ocean-ocean current-land discontinuities in electrical conductivity on an H-polarized mode of an electromagnetic signal in low and high frequencies by numerical modeling were studied. In high frequencies this method was used for deduction of electrical conductivity structure from measurements. Measurements of impedance at the sea floor show effects which could be caused by this anomaly, namely that the conductivity parallel to shore is smaller than normal to it. The results indicated that the distance to which the coastal effect can influence the electric field was quite appreciable. In the case of conductivities higher than 0.001(ohm/m), ohmic conduction in the mantle was important in modeling of the global electrical ocean currents and only if the mantle conduction was lower than 0.001(ohm/m) electric currents would flow around basins. Dissert. Abstr.

N78-21687 Saint Louis Univ., Mo.
SOURCE PARAMETERS AND THE STATIC FIELD OF EARTHQUAKES AT NEAR DISTANCES Ph.D. Thesis
Daniel Huaco 1977 140 p
Avail: Univ. Microfilms Order No. 78-00498

The theory of elasticity shows that three independent equations were necessary to determine the extensional strain at a free surface. Most strainmeter stations were equipped with only two instruments. The comparison was accomplished by first computing strains and tilts for a dislocation model with parameters obtained from a fault plane solution and then comparing these computed measurements to those observed. The comparison in magnitude and polarity proceeded by transforming the static field computed for the fault coordinate system to the coordinate system of each station. The procedure was developed to correlate dislocation theory at near field with fault parameters determined from a fault plane solution, and the comparison of the computed strains and tilts with field observations indicated that the static field observations are adequately described by means of the static field of a dislocation model. Dissert. Abstr.

N78-21688 Saint Louis Univ., Mo.
A NUMERICAL INVESTIGATION OF THE BOUNDARY LAYER OF AN ATMOSPHERIC MESOSCALE VORTEX Ph.D. Thesis
William Harold Raymond 1977 137 p
Avail: Univ. Microfilms Order No. 78-00515

The boundary layer dynamics of idealized axisymmetric vortices were studied and the results were applied to understand meteorological phenomena. Rapid transient motions within a decaying axisymmetric vortex boundary were analyzed for various local Rossby and Reynolds numbers. Both laminar (no-slip) and turbulent (slip) boundary conditions were considered for flows over rotating and stationary surfaces. Similarity transformations were performed by expanding the velocity components in powers of a ratio of dimensionless radius to time. The zeroth order system described by two nonlinear second order ordinary differential equations is solved by Newton's iterative method. Comparisons were made for the special case of laminar flow over a stationary surface. For the first order system, asymptotic solutions representing the flow far above the lower surface are obtained. Dissert. Abstr.

N78-21689 Communications Research Centre, Ottawa (Ontario).
THE RADIO CLIMATOLOGY OF CANADA. TROPOSPHERIC REFRACTIVITY ATLAS FOR CANADA
B. Segal Dec. 1977 178 p refs
(CRC-1315-E) Copyright. Avail: Issuing Activity

Results from three complete, analytically distinct investigations of refractivity factors that profoundly influence radio propagation in the lower atmospheric levels are contained within this atlas. A two-dimensional analysis of weather observations made at the earth's surface is presented, along with a three-dimensional analysis of vertical atmospheric soundings. A statistical summary of the characteristics of radio ducts in the lower atmosphere is

also presented. The results were derived from an independent analysis of a sub-set of the vertical soundings studied. Author

N78-21690*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MICROWAVE EMISSION FROM POLAR FIRN
A. T. C. Chang and B. J. Choudhury (Computer Sciences Corp., Silver Spring, Md.) Apr. 1978 24 p refs
(NASA-TP-1212) Avail: NTIS HC A02/MF A01 CSCL 04A

The microwave emission from a half-space medium, characterized by coordinate dependent scattering and absorbing centers, was calculated by numerically solving the radiative transfer equation by the method of invariant imbedding. Rayleigh scattering phase functions and scattering induced polarization of the radiation were included in the calculation. Using the scattering and extinction data of polar firn the brightness temperature was calculated for the 1.55 cm wavelength. This study was the first quantitative comparison of the results of numerical calculation using the actual measured information of crystal size with the observed data. Author

N78-21691*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE TIDAL OSCILLATIONS OF THE LIQUID CORE OF THE EARTH
Peter Musen Apr. 1978 71 p refs
(NASA-TP-1223; G7802-F11) Avail: NTIS HC A04/MF A01 CSCL 08K

An important goal of a tidal theory is the improvement of nutational amplitude and of the parameters of the earth's elastic response. A theory of tidal oscillations inside a rotating elliptical earth was developed, with special emphasis on tides in the liquid core. The Molodensky and Kramer theory of the resonance effect, as caused by the proximity of the frequency of the free diurnal wobble of the liquid core to the frequency of K sub 1 astronomical tide, was amended to include the effect of the possible deviation of the liquid core from the state of neutral stability. Coupling effects between the toroidal and spheroidal oscillations, as caused by the Coriolis force, were taken into consideration. Author

N78-21692*# Systems and Applied Sciences Corp., Riverdale, Md.
SOFTWARE DEVELOPMENT: STRATOSPHERE MODELING Final Report
H. C. Chen 9 Dec. 1977 14 p
(Contract NAS5-24255)
(NASA-CR-156722; R-SAD-12/77-34) Avail: NTIS HC A02/MF A01 CSCL 04A

A more comprehensive model for stratospheric chemistry and transport theory was developed for the purpose of aiding predictions of changes in the stratospheric ozone content as a consequence of natural and anthropogenic processes. This new and more advanced stratospheric model is time dependent and the dependent variables are zonal means of the relevant meteorological quantities which are functions of latitude and height. The model was constructed by the best mathematical approach on a large IBM S360 in American National Standard FORTRAN. It will be both a scientific tool and an assessment device used to evaluate other models. The interactions of dynamics, photochemistry and radiation in the stratosphere can be governed by a set of fundamental dynamical equations. Author

N78-21693# Lockheed Missiles and Space Co., Palo Alto, Calif.
USE OF THE METHOD OF ONE-DIMENSIONAL NONLINEAR TRANSFORMATIONS TO FORECAST THE NATURAL MODEL OF AN OIL STRATUM
T. A. Badalov [1977] 4 p refs Transl. into ENGLISH of the book "Raspoznavanie Obrazov" Moscow, Nauka, 1977 p 27-30
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The goal of estimating the possibility of forecasting the natural mode of a stratum according to a set of geological-physical criteria and also of setting up a connection between the quantity being forecasted and the criteria is the objective of this paper. Author

N78-21694*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USER'S GUIDE TO THE NIMBUS-4 BACKSCATTER ULTRAVIOLET EXPERIMENT DATA SETS
Barbara E. Lowrey Jan. 1978 96 p
(Contract NAS5-23854)
(NASA-TM-78069) Avail: NTIS HC A05/MF A01 CSCL 04A

The first year's data from the Nimbus 4 backscatter ultraviolet (BUV) experiment have been archived in the National Space Science Data Center (NSSDC). Backscattered radiances in the ultraviolet measured by the satellite were used to compute the global total ozone for the period April 1970 - April 1971. The data sets now in the NSSDC are the results obtained by the Ozone Processing Team, which has processed the data with the purpose of determining the best quality of the data. There are four basic sets of data available in the NSSDC representing various stages in processing. The primary data base contains organized and cleaned data in telemetry units. The radiance data has had most of the engineering calibrations performed. The detailed total ozone data is the result of computations to obtain the total ozone; the Compressed Total Ozone data is a convenient condensation of the detailed total ozone. Product data sets are also included. Author

N78-21695*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE AVERAGE CONFIGURATION OF THE GEOMAGNETIC TAIL
D. H. Fairfield Mar. 1978 11 p refs Submitted for publication
(NASA-TM-78116) Avail: NTIS HC A02/MF A01 CSCL 04A

Over 3000 hours of IMP-6 magnetic field data obtained between 20 and 33 R sub E in the geomagnetic tail have been used in a statistical study of the tail configuration. A distribution of 2.5 minute averages of B sub Z as a function of position across the tail reveals that more flux crosses the equatorial plane near the dawn and dusk flanks than near midnight. The tail field projected in the solar magnetospheric equatorial plane deviates from the X axis due to flaring and solar wind aberration by an angle alpha = -0.9 y sub SM - 1.7 where Y sub SM is in earth radii and alpha is in degrees. After removing these effects the Y component of the tail field is found to depend on interplanetary sector structure. During an away sector the B sub Y component of the tail field is on average 0.5 gamma greater than that during a toward sector, a result that is true in both tail lobes and is independent of location across the tail. Author

N78-21696# Naval Ocean Research and Development Activity, Bay St. Louis, Mo. Sea Floor Div.
INTERPRETATION OF SINGLE-CHANNEL SEISMIC REFLECTION RECORDS
J. Alan Ballard Feb. 1977 49 p refs
(AD-A047511; NORDA-1) Avail: NTIS HC A03/MF A01 CSCL 08/11

The identification of signals recorded on a Single Channel Seismic reflection record is approached from instrumental environmental geometric and geologic viewpoints. Examples show that it is frequently possible to distinguish between noises, recorded instrumental artifacts, and acoustic impedance mismatches indicative of geologically significant structural and sedimentological variations. Analog-to-digital conversion processes introduce little error into the data, but the failure to allow for vertical velocity gradients in the sedimentary column can lead to significant differences between true and apparent depths to reflectors. Failure to consider diffraction effects, vertical exaggeration effects, velocity effects and numerous other factors can lead to serious interpretation errors. Author (GRA)

N78-21697# Naval Research Lab., Washington, D. C.
COMPARISON OF THE 3-5 MICROMETER AND 8-12 MICROMETER REGIONS FOR ADVANCED THERMAL IMAGING SYSTEMS: LOWTRAN REVISITED Interim Report
A. F. Milton, G. L. Harvey, and A. W. Schmidt 30 Dec. 1977 34 p refs
(AD-A049448; AD-E000100) Avail: NTIS HC A03/MF A01 CSCL 04/1

Four spectral bands for advanced infrared imaging systems are compared on the basis of calculations of atmospheric transmission, using the LOWTRAN 3B atmospheric transmission model. Slant paths, MTF effects, and Maritime and Rural aerosol models are included in the analysis. The relative advantage of the 3- to 5-micrometer band is shown to be strongly influenced by the choice of aerosol models. Author (GRA)

N78-21698# Naval Research Lab., Washington, D. C.
HIGH ALTITUDE LIMIT OF THE GRADIENT DRIFT INSTABILITY Interim Report
S. L. Ossakow, P. K. Chaturvedi, and J. B. Workman Nov. 1977 30 p refs
(AD-A049503; AD-E000095; NRL-MR-3639) Avail: NTIS HC A03/MF A01 CSCL 20/9

The gradient drift instability for F region plasma clouds is investigated retaining ion inertia effects. Using the assumption that the ion gyrofrequency, Omega, is greater than inertial time changes (delta/delta T and divergence of V sub I) and the ion-neutral collision frequency, V sub in, a quadratic dispersion equation results. In the limit that V sub in < 4cE sub O/BL (E sub O and B are the ambient electric and magnetic fields, and L is the plasma cloud density gradient scale length), the growth rate, gamma, reduces to the usual result CE sub O/BL. In the opposite limit v sub in > 4cE sub O/BL, gamma = (CE sub O V sub in/BL) to the 1/2 power. This result can explain why high altitude (approximately 450 km) barium releases, where v sub in is less than unity and a factor of 10-100 smaller than at lower altitudes (approximately 200 km), striate on time scales similar to the lower altitude releases. GRA

N78-21699# Martin Marietta Labs., Baltimore, Md.
INTERNAL GRAVITY WAVE GENERATION BY VORTEX WAKES Final Report, 1 Aug. 1974 - 30 Sep. 1977
S. C. Traugott Dec. 1977 57 p refs
(Contract F44620-75-C-0009)
(AD-A049515; MML-TR-77-71C; AFOSR-77-1309TR) Avail: NTIS HC A04/MF A01 CSCL 20/4

During this time the investigation focused on various details relating to the numerical prediction of buoyant vortex wakes, and also on the prediction of radiative decay rates of atmospheric waves. A calculation of the complete vortex wake including buoyancy was not completed by the termination date. However, fundamental contributions were made on issues relating to numerical false viscosity effects at large Reynolds number, and to the prediction of the descent velocity of a closely interacting vortex pair. GRA

N78-21700# Air Force Geophysics Lab., Hanscom AFB, Mass.
THERMOCHEMICAL AND KINETIC DATA OF GASEOUS METAL OXIDES AND THEIR RELATIONSHIP TO ATMOSPHERIC COMPOSITION Interim Report, 1 Oct. 1976 - 30 Sep. 1977
Edmond Murad 26 Oct. 1977 32 p refs
(AF Proj. 6690)
(AD-A050162; AFGL-TR-77-0235; AFGL-ERP-610) Avail: NTIS HC A03/MF A01 CSCL 04/1

The dissociation energies and ionization potentials of gaseous monoxides and dioxides of some metals are surveyed, and best values for these quantities are given. In addition, a survey is made of the kinetic data for the formation and destruction of these species and the results are tabulated. The relationship of these quantities to atmospheric composition is discussed, and it is shown that monoxide ions are converted to metal ions very quickly by reaction with atomic oxygen. Author (GRA)

N78-21701# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.
ATMOSPHERIC DIFFUSION: SIMILARITY THEORY AND EMPIRICAL DERIVATIONS FOR USE IN BOUNDARY LAYER DIFFUSION PROBLEMS
G. A. Ethridge and F. V. Hansen Fort Monmouth, N.J. ECOM Nov. 1977 43 p refs
(AD-A050027; ECOM-5832) Avail: NTIS HC A03/MF A01 CSCL 04/2

Functional forms specifying the diffusion characteristics for turbulent flow in the atmosphere are developed, based on the similarity theory of the surface boundary layer. Descriptors of concentration and vertical spread for a continuous point source near the earth's surface are developed. Comparison to other treatises and to observational data both support the approach and confirm the accuracy of the method taken herein. Author (GRA)

N78-21702# Naval Ocean Systems Center, San Diego, Calif. EM Propagation Div.
IONOSPHERIC REFLECTION AND ABSORPTION PROPERTIES OF NORMAL MODES AT ELF Interim Report, Jan. - Sep. 1977
R. A. Pappert and L. R. Shockey 15 Sep. 1977 110 p refs
(DNA MIPR 77-522)
(AD-A049778; NOSC/IR-772) Avail: NTIS HC A06/MF A01 CSCL 04/1

As an aid to better understanding ELF propagation in the earth-ionosphere waveguide, full-wave ELF modal height gains are analyzed as regards regions of reflection and absorption. Frequencies in the Schumann and Seafarer bands are discussed for representative day/night, ambient and disturbed ionospheres. Enhancement of the earth-ionosphere waveguide attenuation due to Sporadic E layering is discussed and the origin of the enhancement clarified. Author (GRA)

N78-21703# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
APPROXIMATE SOLUTIONS TO THE RADIATIVE TRANSFER EQUATION USING THE ELSASSER SCHEME M.S. Thesis - Utah Univ.
Paul Joseph Breslin Aug. 1977 66 p refs
(AD-A049933; AFIT-CI-78-25) Avail: NTIS HC A04/MF A01 CSCL 04/1

The purpose of this study is to analyze and compare the atmospheric radiative fluxes and cooling rates resulting from two approximations. As a norm for the comparison, a quasi-exact solution is also applied. This is accomplished by using the EC formulation of the generalized absorption coefficient. Calculations are carried out for two model atmospheres for part of the 6.3 micron water vapor band. It is found that the Z approximation is more accurate for the downward fluxes and the CH approximation is more accurate for the upward fluxes. For the model atmospheres studied the cooling rate errors are usually smaller for the Z approximation, unless the divergence of the net flux is extremely small. GRA

N78-21704# Naval Postgraduate School, Monterey, Calif.
MEASUREMENT OF NEAR SEA SURFACE TURBULENCE AND POSSIBLE WAVE INFLUENCE M.S. Thesis
James H. Corbin Sep. 1977 73 p refs
(AD-A049951) Avail: NTIS HC A04/MF A01 CSCL 04/1

Measurements were made at three levels above the sea surface to observe possible wave influence on turbulence parameters. Two levels, at one and three meters above the sea surface were mounted on a small floating platform tethered to the bow of the R/V Acania. The third level, at 6.6 meters above the sea surface, was mounted on a boom on the bow of the ship. Measurements were made of mean wind, mean temperature, mean humidity, and of the fluctuating temperatures and velocities at all three levels. These data were interpreted on the basis of empirically derived expressions describing the temperature structure function parameter, C sub T squared, and the rate of dissipation of turbulent kinetic energy. For optical relevance, C sub T squared was related to the refractive index structure function parameter. Results show qualitatively that there is a substantial wave influence near the sea surface, and that the system and procedures used to obtain the data produce valid measurements for deriving the wave influence on turbulence and on optical transmission in the near sea surface layer adjacent to the waves. GRA

N78-21705# Systems Science and Software, La Jolla, Calif.
SEISMIC STUDIES OF SURFACE AND BODY WAVES FOR IMPROVED YIELD DETERMINATION Quarterly Report, 1 Jul. - 30 Sep. 1977
T. C. Bache and W. L. Rodi Oct. 1977 88 p refs
(Contract F08606-76-C-0041)
(AD-A049958; SSS-R-78-3448) Avail: NTIS HC A05/MF A01 CSCL 17/10

The majority of the report is devoted to describing the results of two research projects not previously reported. One of these, Determination of Crustal Structure from Surface Wave Dispersion Data, describes a recently developed method for obtaining crustal structure and gives results from application of this method to two paths in the southwestern United States: Nevada Test Site (NTS) to Albuquerque, New Mexico and NTS to Tucson, Arizona. Phase and group velocities are determined from NTS explosion recordings. Theoretical seismograms computed with the new crustal models show remarkable agreement with observations of NTS explosions at the two stations. The second research study described is entitled Small-Scale Laboratory Simulations of Explosion Produced Body Waves - Implications for the Teleseismic Signatures of Underground Nuclear Explosions. Small-scale laboratory experiments were carried out to measure the ground motions from spherical charges. The most important feature of the experimental data is a large negative pulse that occurs at late-time in the experiments that include free-surface effects. Much of the study is directed toward determining the effect a pulse of this kind would have on the teleseismic body waves from nuclear explosions and m sub b-log yield relations. GRA

N78-21706# Analytic Sciences Corp., Reading, Mass.
GEOFAST: A FAST GRAVIMETRIC ESTIMATION ALGORITHM Final Report, 26 Jul. 1976 - 25 Aug. 1977
Warren G. Heller, Kevin S. Tait, and Stephen W. Thomas 25 Aug. 1977 65 p refs
(Contract F19628-76-C-0286)
(AD-A047611; TASC-TR-1007-1-1; AFGL-TR-77-0195) Avail: NTIS HC A04/MF A01 CSCL 08/5

A mathematical algorithm called GEOFAST which uses modern frequency domain estimation techniques is developed for estimating gravity quantities such as the undulation of the geoid and the gravity disturbance vector. GEOFAST removes a restriction associated with an earlier algorithm, namely that data tracks be significantly longer than the correlation distances of the gravity quantities being measured. In the new algorithm no restrictions are placed on data track length. Author (GRA)

N78-21707# Battelle Columbus Labs., Ohio.
THE FATE OF NITROGEN OXIDES IN THE ATMOSPHERE: SUMMARY OF AN EXPLORATORY STUDY IN PHOENIX, ARIZONA Final Report
C. W. Spicer, D. W. Joseph, and John Kouyoumjian Mar. 1977 41 p refs
(PB-276355/5) Avail: NTIS HC A03/MF A01 CSCL 04A

The feasibility of carrying out a large scale NOx atmospheric chemistry field program was conducted. The study involved monitoring of NO, NOx, PAN, HNO3 and particulate nitrogen species within and downwind of Phoenix. GRA

N78-21708# National Oceanic and Atmospheric Administration, Boulder, Colo. Space Environment Lab.
A DIVISION OF THE aa INDICES INTO SIX CLASSES BASED ON THE Ap' INDEX, 1868-1976
Joseph A. Sutorik and Cheryl M. Cruickshank Jul. 1977 17 p
(PB-276388/6; NOAA-TR-ERL-389; NOAA-77120105) Avail: NTIS HC A02/MF A01 CSCL 04A

These data provide a 109 year history of the geomagnetic field for active or storm day conditions. An analysis of the 109 year record suggests that coronal holes occurred in each of the last 10 solar cycles. Though coronal holes predominantly appear in the declining years of a solar cycle, they may appear throughout a cycle. In addition, the study analyzes monthly, annual, and solar cycle distributions and predicts a course for solar cycle 21. GRA

N78-21709# Los Alamos Scientific Lab., N. Mex.
PETROGRAPHY AND GEOCHEMISTRY OF PRECAMBRIAN ROCKS FROM GT-2 AND EE-1
A. W. Laughlin and A. Eddy Aug. 1977 50 p refs
(Contract W-7405-eng-36)
(LA-6930-MS) Avail: NTIS HC A03/MF A01

During the drilling of GT-2 and EE-1, 27 cores totaling about 35 m were collected from the Precambrian section. Samples of each different lithology in each core were taken for petrographic and whole-rock major and trace element analyses. Geophysical logs and cuttings were used to extrapolate between cores. The most abundant rock type was an extremely variable gneissic unit comprising about 75% of the rock penetrated. This rock was strongly foliated and ranged compositionally from syenogranitic to tonalitic over a few centimeters. ERA

N78-21710# California Univ., Berkeley. Lawrence Berkeley Lab.
ANALYSIS OF THE BIPOLE-DIPOLE RESISTIVITY METHOD FOR GEOTHERMAL EXPLORATION
A. Dey Jun. 1977 63 p refs
(Contract W-7405-eng-48)
(LBL-6332) Avail: NTIS HC A04/MF A01

Apparent resistivities were blotted at roving dipole receiver locations and the current source (bipole) was left fixed. Interpretation to date was in terms of simple layered, dike, vertical contact, or sphere models. In the case of more complicated two dimensional models the interpretation was ambiguous and the detection of buried conductors depended on the choice of transmitter location. Since apparent resistivities taken on a line collinear with the bipole were roughly equivalent to the apparent resistivities for one sounding in a dipole-dipole pseudo-section, the two methods were compared for several two dimensional models. ERA

N78-21711# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
USMR (WHITE SANDS MISSILE RANGE) ATMOSPHERIC STRUCTURE CONSTANT (C SUB n, SUP 2) SURVEY
R. B. Fritz and R. S. Lawrence Sep. 1977 147 p refs Sponsored in part by Army ECOM
(PB-276097/3; NOAA-TM-ERL-WPL-27; NOAA-77112303) Avail: NTIS HC A07/MF A01 CSCL 04A

Ground based and rawinsonde measurements were conducted of the refractive index structure constant (C sub n, sup 2) wind, temperature, humidity, and pressure. Measurements were taken of (C sub n, sup 2) using an aircraft mounted temperature probe, including vertical profiles to 3000 meters above ground and constant altitude circuit surveys. The aircraft measurements and concurrent rawinsonde launches occurred at approximately local midnight, dawn, noon, and sunset. GRA

N78-21712# Pennsylvania State Univ., University Park.
EMPIRICAL DETERMINATION OF VERTICAL DIFFUSION COEFFICIENTS FOR LOS ANGELES
Gary Crane and Hans A. Panofsky Aug. 1977 34 p refs Sponsored by Coordinating Research Council, Inc., New York
(PB-275756/5; CRC-APRAC-CAPA-12-72) Avail: NTIS HC A03/MF A01 CSCL 04A

Coefficients depicting the morning boundary layer in Los Angeles were computed by integrating vertically changes of concentrations of nonreactive pollutants along horizontal trajectories. Mixing coefficients were determined for three separate periods and analyzed according to the hypothesis of convective similarity. Normalized mixing coefficients were represented as universal functions of the ratio of the height to the mixing depth. These functions were relatively small at low altitudes and reached a maximum at about half the mixing depth. In the surface layer, the mixing coefficients agreed with the hypothesis that mixing coefficients for contaminants equal mixing coefficients for momentum (eddy viscosity). The observed universal functions also agreed fairly well with predictions made from second-order closure theory. GRA

N78-21713# Stanford Research Inst., Menlo Park, Calif. Center for Resource and Environmental Systems Studies.
EARTHQUAKE PREDICTION UNCERTAINTY, AND POLICIES FOR THE FUTURE: A TECHNOLOGY ASSESSMENT OF EARTHQUAKE PREDICTION Final Report
L. W. Weisbecker, W. C. Stoneman, and S. E. Ackerman Jan. 1977 311 p refs
(Grants NSF GI-43870; NSF ERS-76-21353)
(PB-275581/7; CRESS-19; NSF-RA-770161) Avail: NTIS HC A14/MF A01 CSCL 08K

The purpose of this summary is to present--for the benefit of public policymakers and administrators, scientists, businessmen, special interest groups, private citizens, and the media--the findings of a recent comprehensive technology assessment of earthquake predictions. This assessment focuses on the follow-

ing: (1) background on earthquakes; (2) outlook for earthquake prediction; (3) responding to earthquake predictions; (4) public policy issues related to earthquake prediction; (5) regional planning for uncertain predictions; and the long-term outlook. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N78-21714 Colorado State Univ., Fort Collins.
OROGRAPHIC PRECIPITATION MODEL FOR HYDRO-METEOROLOGICAL USE Ph.D. Thesis
John Owen Rhea 1977 216 p
Avail: Univ. Microfilms Order No. 78-02393

Research was performed to determine the ability to diagnose the effect of topography on winter precipitation for western Colorado over various time periods for differing wind regimes, employing upper air data and a fine mesh topographic grid. The derived method has utility in assessing the average magnitude and the interseason variation of topographic effects on winter precipitation in western Colorado and as an objective aid for quantitative precipitation forecasting. It has substantial potential utility as input to hydrologic process models for streamflow forecasting. The basic approach should be transferable to other topographically complex areas which are dominated by stratiform precipitation. Dissert. Abstr.

N78-21715 Colorado State Univ., Fort Collins.
PHYSICAL MECHANISMS OF EXTRA AREA EFFECTS FROM WEATHER MODIFICATION Ph.D. Thesis
Gerald John Mulvey 1977 151 p
Avail: Univ. Microfilms Order No. 7802386

The physical mechanisms by which cloud seeding projects may cause extra area effects were investigated. The investigations center on one of the simplest of precipitating systems, namely the cold wintertime orographic clouds of the central Rocky Mountains. Three lines of investigation were followed: (1) field studies of seeding material movement in the atmosphere and receiver cloud characteristics, (2) numerical simulation, and (3) historical studies of the affected cloud system. These studies show that at least two feasible mechanisms through which mountain orographic clouds can affect the precipitation on the eastern plains exist, and, under certain conditions, are operative. Dissert. Abstr.

N78-21716 Pennsylvania State Univ., University Park.
THE DEVELOPMENT OF A MESOSCALE SEMI-IMPLICIT NUMERICAL MODEL Ph.D. Thesis
Nelson Lawrence Seaman 1977 232 p
Avail: Univ. Microfilms Order No. 7803367

A mesoscale three dimensional semi-implicit numerical model was derived from the Navier-Stokes equations of atmospheric flow. Complex terrain was included in the model, but several other physical effects, such as diabatic heating, moisture, and surface friction, were neglected. The neglected terms were not crucial to the basic development of the model. Because the periods of mesoscale meteorological systems are closer to those of atmospheric gravity waves than are those of synoptic scale waves, the applicability of the semi-implicit technique to the large scales is also supported. Thus, the research has been successful in verifying and extending the use of the semi-implicit technique in the field of numerical atmospheric modeling. Dissert. Abstr.

N78-21717*# Oklahoma Univ., Norman.
THE MODIFICATION AND APPLICATION OF KUO'S PARAMETERIZATION OF CUMULUS CONVECTION IN MIDDLE LATITUDES Final Report
Wen-Jey Liang Apr. 1978 100 p refs
(Contract NAS8-31333)
(NASA-CR-2998; M-249) Avail: NTIS HC A05/MF A01 CSCL 04B

An evaluation to reveal physical insight into the involved mechanisms through a combination of the large scale heat and moisture budgets and formulation of the latent heat released was performed. To improve upon the treatment of the interaction of deep convection with the environment, modifications consisting of considerations of the large scale moisture supply and of the vertical transport of moisture and of dry static energy inside the cloud are made. Also, a two layer cloud ensemble model is combined with the modified scheme. An examination of the modified scheme is performed by combining the large scale heat and moisture budgets and the modified formulation of the latent heat released. The modified parameterization procedures are compared with the original scheme, and the results of tests of both schemes are discussed. A variational optimization scheme is developed to analyze the wind field such that the integrated continuity equation and the global boundary condition are satisfied. Author

N78-21718*# Commerce Dept., Washington, D.C.
WORLD WEATHER PROGRAM. PLAN FOR FISCAL YEAR 1978
Sep. 1977 80 p Sponsored in part by NASA, EPA, and NSF
(PB-276479/3; NOAA-77120503) Avail: NTIS HC A05/MF A01 CSCL 04B

The U.S. initiatives carried out by Federal agencies which either directly support or contribute to the goals of the World Weather Program are described. The lessons learned and application of the results from the recently concluded Data Systems Tests are highlighted. These tests were designed as controlled investigations into the operation of the observing, data communications, and data processing systems likely to be available for FGGE-the Global Weather Experiment. The relationship of our national activities with those of other nations cooperating in the World Weather Program is discussed. GRA

N78-21719*# Systems and Applied Sciences Corp., Riverdale, Md.
ANALYSIS OF GLOBAL OCEANIC RAINFALL FROM MICROWAVE DATA Final Report
Mirle Rao 3 Jan. 1978 7 p
(Contract NAS5-23852)
(NASA-CR-156737; R-SAD-1/78-36) Avail: NTIS HC A02/MF A01 CSCL 04B

A Global Rainfall Atlas was prepared from Nimbus 5 ESMR data. The Atlas includes global oceanic rainfall maps based on weekly, monthly and seasonal averages, complete through the end of 1975. Similar maps for 1973 and 1974 were studied. They reveal several previously unknown areas of enhanced rainfall and preliminary data on interannual variability of oceanic rainfall. Author

N78-21720*# Hughes Aircraft Co., Los Angeles, Calif. Space and Communications Group.
SEVERE STORMS OBSERVING SATELLITE (STORMSAT) Final Report
Aug. 1976 196 p refs
(Contract NAS5-20812)
(NASA-CR-156735; SCG-60320R) Avail: NTIS HC A09/MF A01 CSCL 04B

The primary payload for this satellite is the Advanced Atmospheric Sounding and Imaging Radiometer which will perform precise infrared temperature sounding and visible/infrared imaging from geostationary orbit. A secondary payload instrument which may be utilized on STORMSAT is the Microwave Atmospheric Sounding Radiometer which provides an independent set of temperature and humidity sounding in cloudy, meteorologically active regions. The study provides satellite designs and identifies mission-unique subsystems using the Multimission Modular Spacecraft using a Shuttle/Interim Upper Stage launch vehicle. Author

N78-21721# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A STUDY OF THE CHARACTERISTICS OF THE DATA SYSTEMS TEST KINEMATIC FIELDS M.S. Thesis - Utah Univ., Salt Lake City
Allan Joseph McGlasson Aug. 1977 79 p refs
(AD-A050060; AFIT-CI-78-32) Avail: NTIS HC A05/MF A01 CSCL 04/2

Winter 1976 Data Systems Test wind data was used to

produce a number of global kinematic fields. An interpolation scheme was developed to move the wind data from sigma levels to constant pressure levels. Time-averaged fields of the zonal wind component, meridional wind component, divergence, vorticity, steady energy and transient energy were computed for 200 mb, 500 mb and 850 mb. In addition, the standing kinetic energy and transient kinetic energy were decomposed by wavenumbers into energy spectra 200 mb and 500 mb for different latitudes. Results of this research were compared with other similar studies and showed favorable correlation. Resolution of synoptic scale features was good. Organized areas were found in the time-averaged divergence fields indicating that divergence features can be resolved in this data. GRA

N78-21722# Naval Postgraduate School, Monterey, Calif.
RESPONSE OF THE UPPER OCEAN TO HURRICANE ELOISE M.S. Thesis
Laurence Victor Friese Dec. 1977 54 p refs
(AD-A050245) Avail: NTIS HC A04/MF A01 CSCL 04/2

Buoy data provided clear evidence of mixed layer deepening and an internal wave caused by Hurricane Eloise, September 1975. Logarithmic temperature profiles below an isothermal mixed layer were assumed and used to model thermocline oscillation and heat budget calculation as influenced by Eloise over a 21-day period. Results show that prior to the arrival of Eloise at the buoy, the average mixed layer depth was about 33 m. As the winds increased due to hurricane approach, the mixed layer deepened steadily to about 42 m before upwelling to approximately 22 m. The thermocline then underwent three distinctly large oscillations of inertial periodicity, while the mixed layer continued to deepen. The post-storm average mixed layer depth was about 52 m. Values of mixed layer depth were concluded to be accurate to within 2 m. Vertical velocities, calculated first by assuming zero horizontal temperature advection in the material derivative equation and second by finding the mass transport necessary to balance the heat budget, show that in the upper 500 m of the water column downward vertical motion of 1 m/hr or less prevailed during storm approach, followed by upward vertical velocity as great as 5.35 m/hr during the 12 hr immediately following hurricane passage followed by downward vertical velocity during the large thermocline oscillations.
Author (GRA)

N78-21723# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
FORECASTING THUNDERSTORMS OVER A 2-TO-5-H PERIOD BY STATISTICAL METHODS Ph.D. Thesis - Texas A. and M. Univ.
Joseph A. Zak Aug. 1977 129 p refs
(AD-A050005; AFIT-CI-78-29) Avail: NTIS HC A07/MF A01 CSCL 04/2

Classical statistical techniques, such as multiple regression with variable selection and principal component analysis, were employed to define combinations of parameters from meteorological observations which optimally discriminate between the occurrence and nonoccurrence of thunderstorms. Routine observations of weather elements at five levels in the troposphere during two spring and summer seasons were analyzed objectively onto a 65 km grid which spanned much of the central United States. A thunderstorm occurrence was defined from manually digitized radar (MDR) observations with an MDR code of four or greater as the basis. The binary variable one or zero for occurrence or non-occurrence, respectively, was the predictand. Parameters which are measures of atmospheric moisture content, stability, and trigger mechanisms were calculated from gridded fields of surface and upper-air observed elements for different times each morning. These parameters were candidate predictors in the variable-selection procedures. Data from all grid points and for each day were pooled in order to provide an adequate sample of thunderstorm observations. GRA

N78-21724# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
CHARACTERISTIC SIZE SPECTRA OF CUMULUS FIELDS OBSERVED FROM SATELLITES M.S. Thesis - Colorado State Univ.
Malcolm Douglas Gifford 1977 89 p refs
(AD-A049936; AFIT-CI-78-28) Avail: NTIS HC A05/MF A01 CSCL 04/2

A technique is presented which allows the investigator to monitor size distributions of small scale cumulus fields using satellite data. The limitations of the technique are shown to be the resolution and quality of the satellite imagery. Twenty-four samples of small cumulus are studied using DMSP and SMS-1 satellite imagery. A total of eleven DMSP samples are examined from North Carolina and Florida. These samples are compared to six DMSP samples and seven SMS-1 samples drawn from cumulus fields observed over the subtropical and tropical Atlantic Ocean. Comparisons are based on parameters derived from the least-squares solutions of a linearized first order exponential model. An exponential decrease in cloud number density with increasing cloud diameter is exhibited in both the mean cloud number density distributions of the case studies and the mean cloud number density distributions of selected typical cumulus samples. The poorer data quality of the SMS-1 imagery is seen to cause deviations from the exponential model in approximately 40% of the samples. GRA

N78-21725# Air Weather Service, Scott AFB, Ill.
SELECTED TOPICS IN STATISTICAL METEOROLOGY Final Report
Robert G. Miller, ed., Bruce D. Altenhof, Jimmy N. Fulford, William S. Weaving, William W. Neubert, Wendell M. Pool, Jr., Jeanette M. Heumann, Roger C. Whiton, John W. Louer, James W. Taylor et al Jul. 1977 172 p refs
(AD-A050035; AWS-TR-77-273) Avail: NTIS HC A08/MF A01 CSCL 04/2

This report is a compilation of papers on statistical meteorology resulting from a graduate course at Saint Louis University on special topics in statistical meteorology. Methodologies covered include: preliminary mathematics, screening regression, multiple discriminant analysis, regression estimation of event probabilities, Markov processes, nonlinear prediction, Delphi technique, and the results of a single station forecasting experiment. Numerous examples are included. Appendices cover computer programs on screening predictors, Crout matrix operations, and REEP.
Author (GRA)

N78-21726# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex. Meteorological Team.
THE 12829C LANCE MISSILE NO. 4236, ROUND NO. 299 RSL, 25 AUGUST 1977
Sep. 1977 22 p
(DA Proj. 1T6-65702-D-127)
(AD-A049435; DR-944) Avail: NTIS HC A02/MF A01 CSCL 04/2

Meteorological data gathered for the launching of 12829C Lance, Missile Number 4236, Round Number 229 RSL, are presented in tabular form. Author (GRA)

N78-21727# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex. Meteorological Team.
THE 14821A LANCE MISSILE NO. 3294, ROUND NO. 301 APL, 5 OCTOBER 1977
Oct. 1977 39 p
(DA Proj. 1T6-65702-D-127)
(AD-A049431; DR-946) Avail: NTIS HC A03/MF A01 CSCL 04/2

Meteorological data gathered for the launching of 14821A Lance, Missile No. 3294, Round No. 301 APL, are presented in tabular form. Author (GRA)

N78-21728# Atmospheric Sciences Lab., White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
THE 14823A LANCE MISSILE NO. 3293, ROUND NO. 300 AST, 5 OCTOBER 1977
Oct. 1977 37 p
(DA Proj. 1T6-65702-D-127)
(AD-A049430; DR-945) Avail: NTIS HC A03/MF A01 CSCL 04/2

Meteorological data gathered for the launching of 14823A Lance, Missile No. 3293, Round No. 300 AST, are presented in tabular form. Author (GRA)

N78-21729# Naval Postgraduate School, Monterey, Calif.
A STATISTICAL STUDY OF SYNOPTIC STORM ACTIVITY

OVER THE NORTH PACIFIC IN 1975 M.S. Thesis
Gary Charles Heise Dec. 1977 52 p refs
(AD-A050052) Avail: NTIS HC A04/MF A01 CSCL 04/2

A statistical analysis was made of the 00 and 12 GMT surface wind analysis prepared by Fleet Numerical Weather Central (FNWC) during 1975 to describe the synoptic storm activity over the North Pacific Ocean. Temporal variance of the surface wind components at each individual gridpoint was 'band passed' (approximately 2.5-6 days) using the filtering procedure of Blackmon (1976). Both the original winds and the time-filtered wind components were used to calculate the cube of the friction velocity and the wind stress curl. Monthly mean maps of u^*3 from the filtered wind components show clearly the location and intensity of the monthly mean synoptic storm activity during this period. Also, this measure of the synoptic storm activity was qualitatively related to the monthly mean sea surface temperature (SST) anomalies as analyzed by Namias. GRA

N78-21730# National Severe Storms Lab., Norman, Okla.
NATIONAL SEVERE STORMS LABORATORY: PROGRAM AND HISTORY
Edwin Kessler Jun. 1977 74 p refs
(PB-276402/5; NOAA-77120106) Avail: NTIS HC A04/MF A01 CSCL 04B

The current program exploits the pioneering work done at NSSL in multiple Doppler radar observation of wind fields in severe thunderstorms. The program uses innovations in Doppler radar engineering to fill meteorological observing requirements and synthesized Doppler wind field measurements with measurements from special aircraft, satellites, and conventional networks to obtain a coherent model of the severe thunderstorm. The Laboratory's work has led to significant improvement in techniques for forecast and warning of severe storms by operational weather services. Author (GRA)

N78-21731# North American Weather Consultants, Goleta, Calif.
METHODS FOR ESTIMATING AREAL PRECIPITATION IN MOUNTAINOUS AREAS Final Report
Robert D. Elliott 31 Oct. 1977 190 p refs
(Grant NOAA-6-35358)
(PB-276140/1; Rept-77-13; NOAA-77111506) Avail: NTIS HC A09/MF A01 CSCL 04B

The development and testing of a method for predicting the distribution of precipitation over a mountainous watershed is presented. A simple numerical model is developed knowing the basic wind direction and speed, and various cloud and air mass parameters. The method was tested on one well instrumented mountain barrier and then extended to four other barriers. The tests indicated the method's precipitation pattern prediction capability is good over the barrier where the sounding data were good but was weak over the other barriers. However, the method appears to have a general capability in account for pattern changes with wind direction. GRA

N78-21732# National Environmental Satellite Service, Washington, D. C.
A REPORT ON THE CHESAPEAKE BAY REGION NOWCASTING EXPERIMENT
Roderick A. Scofield and Carl E. Weiss Dec. 1977 60 p refs
(PB-277102/0; NOAA-TM-NESS-94; NOAA-78011603) Avail: NTIS HC A04/MF A01 CSCL 04B

NOWCASTS were designed to give timely and detailed weather information to the Bay community. High-resolution (1 km) satellite imagery, infrared satellite data, WBRR radar data, and a mesonetwork of surface observations around the Bay provided data for the experiment. The NOWCASTING experiment demonstrated the feasibility of preparing and disseminating hourly updated weather information via VHF and AM/FM radio. Schematic models of Chesapeake Bay low level winds under various prevailing wind directions were developed using the cumulus distribution as seen in the high resolution satellite imagery. GRA

N78-21733# National Oceanic and Atmospheric Administration, Boulder, Colo. Weather Modification Program Office.
A METHOD FOR ASSESSMENT OF THE NATURAL VARIABILITY FOUND IN HURRICANES THROUGH USE OF RANKING TECHNIQUES AND NONPARAMETRIC STATISTICS
Richard W. Knight (National Hurricane and Experimental Meteorology Lab., Coral Gables, Fla.) Oct. 1977 41 p refs
(PB-276430/6; NOAA-TM-ERL-WMPO-40; NOAA-77120103)
Avail: NTIS HC A03/MF A01 CSCL 04B

A method is presented for quantifying the temporal variability found in hurricanes. The method is based upon nonparametric tests which use ranking techniques. Data taken from Hurricane Debbie (1969) on two days are processed and the results are presented. GRA

N78-21734# National Oceanic and Atmospheric Administration, Washington, D. C. Environmental Data Service.
MARINERS WEATHER LOG, VOLUME 21, NUMBER 6, NOVEMBER 1977
Elwyn E. Wilson Nov. 1977 78 p
(PB-276467/8; NOAA-77120702) Avail: NTIS HC A05/MF A01 CSCL 04B

This issue contains the following articles: SEASAT-A and NIMBUS-G applications to marine weather; Hong Kong as a typhoon haven; and Great Lakes ice season. GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N78-21735 Columbia Univ., New York.
TEMPERATURE FINE-STRUCTURE IN THE SOUTHERN OCEAN Ph.D. Thesis
Daniel Taylan Georgi 1977 347 p
Avail: Univ. Microfilms Order No. 78-02326

Areal distributions of interleaving and histograms of various properties of the temperature fine structure were presented; it was shown that most interleaving or fine structure was associated with frontal regions: polar front, Antarctic continental slope front, and the subtropical convergence south of Africa. The decreased degree of interleaving found south of Africa was attributed to the lack of a well defined Antarctic circumpolar current axis. Considerably more temperature and salinity fine structure was evident in the deep waters of this region, which was believed to be related to isopycnal mixing. Evidence is presented that temperature and salinity fine structure in the polar front zone is density compensated and probably related to ispycnal mixing. Similarly, the fine structure in the Antarctic continental slope front was found to be density compensated. Dissert. Abstr.

N78-21736 Washington Univ., Seattle.
IDENTIFICATION AND TRACING OF WATER MASSES WITH AN APPLICATION NEAR THE GALAPAGOS ISLANDS Ph.D. Thesis
James Jay Anderson 1977 157 p
Avail: Univ. Microfilms Order No. 78-00905

An isentropic analysis was used where water mass distributions were determined on density surface using a number of chemical properties. Distributions of oxygen and salinity along sigma-t surfaces, were used to trace three water masses. The distributions of water masses were represented as fractions that made up sample waters taken within a study area. This assumed that sample water characteristics were formed entirely by mixing along density surfaces. The actual characteristics were formed by these and additional disregarded factors, which produced errors in the calculated fractions of water masses in the sample waters. The error analysis was based on a model that assumed water in a density interval was described as discrete parcels that advected through the study area and exchanged water across their boundaries. A response equation that defined the rate of exchange of material between parcels was developed and used to estimate the effect of mixing on the error terms. Dissert. Abstr.

N78-21737*# National Aeronautics and Space Administration. Wallops Station, Wallops Island, Va.
REMOTE SENSING OF GULF STREAM USING GEOS-3 RADAR ALTIMETER
Clifford D. Leitao, Norden E. Huang (EG and G Washington

Anal. Serv. Center, Inc., Pocomoke City, Md.), and Carlos G. Parra Apr. 1978 34 p refs
(NASA-TP-1209) Avail: NTIS HC A03/MF A01 CSCL 08J

Radar altimeter measurements from the GEOS-3 satellite to the ocean surface indicated the presence of expected geostrophic height differences across the the Gulf Stream. Dynamic sea surface heights were found by both editing and filtering the raw sea surface heights and then referencing these processed data to a 5 minute x 5 minute geoid. Any trend between the processed data and the geoid was removed by subtracting out a linear fit to the residuals in the open ocean. The mean current velocity of 107 + or - 29 cm/sec calculated from the dynamic heights for all orbits corresponded with velocities obtained from hydrographic methods. Also, dynamic topographic maps were produced for August, September, and October 1975. Results pointed out limitations in the accuracy of the geoid, height anomaly deteriorations due to filtering, and lack of dense time and space distribution of measurements. Author

N78-21738# Naval Research Lab., Washington, D. C. Advanced Space Sensing Applications Branch.

ESTIMATION OF MARINE ENVIRONMENTAL PARAMETERS USING MICROWAVE RADIOMETRIC REMOTE SENSING SYSTEMS Interim Report

MacMillan M. Wisler and James P. Hollinger Nov. 1977 59 p refs
(WF52551718)
(AD-A049507; AD-E000096; NRL-MR-3661) Avail: NTIS HC A04/MF A01 CSCL 08/10

This is an interim report on an ongoing program to develop a passive microwave system for the remote all-weather measurement of sea surface temperature from a satellite platform. It presents a general method for obtaining optimal linear algorithms for the reduction of multifrequency radiometer data to determine marine environmental variables. The mean square errors in determining the environmental variables are also determined thereby enabling the evaluation of different passive microwave radiometric systems. This method, called the 'Environmental Transfer Function', includes in its analysis the error contributions from three sources: errors in measuring microwave brightness temperature, the statistical variances of the environmental parameters, and uncertainties in the equations used to relate the brightness temperatures to the environmental parameters. The mathematical formulation is first developed and then an example application is given to evaluate the remote sensing capability of selected radiometric systems. Author (GRA)

N78-21739# Naval Postgraduate School, Monterey, Calif.

UPPER OCEAN THERMAL STRUCTURE FORECAST EVALUATION OF A MODEL USING SYNOPTIC DATA M.S. Thesis

William Fawver Johnson Sep. 1977 48 p refs
(AD-A048526) Avail: NTIS HC A03/MF A01 CSCL 08/3

A one-dimensional model is used to simulate ocean thermal structure response to synoptic scale atmospheric forcing data at six locations. The atmospheric forcing data (Solar Radiation, Total Heat Flux and Marine Winds) were obtained from Fleet Numerical Weather Central (FNWC) Primitive Equation and Marine Wind Models. Data used to initialize and verify the ocean thermal structure originated from bathythermograph data stored at FNWC. Length of simulation ranged from 72 hours to 36 days and was limited by the length of continuous historical data available for study. Results show the forcing functions contain sufficient resolution to define diurnal and synoptic time scale events. When the model is run using these forcing functions it produces changes in the mixed-layer depth and mixed-layer temperature on the same time scales. The magnitude of these changes ranged typically from diurnal fluctuations of 20 m/day and .3 C during summer conditions to synoptic scale deepening of 50 m and cooling by 2 C in 36 days during winter conditions. These results were verified when observations were present in this area. The capability now exists to produce real time dynamic ocean thermal profiles in areas of infrequent observations and also to forecast changes in ocean thermal structure up to 72 hours from the time of an observation. GRA

N78-21740# Naval Postgraduate School, Monterey, Calif.

DYNAMICAL NUMERICAL PREDICTION OF LARGE-SCALE THERMAL ANOMALIES IN THE NORTH PACIFIC OCEAN M.S. Thesis

Wayne Stuart Shiver Dec. 1977 48 p refs
(AD-A049919) Avail: NTIS HC A03/MF A01 CSCL 08/3

A ten-level primitive equation ocean circulation model is used to investigate the formation and evolution of large-scale thermal anomalies observed in the central North Pacific Ocean during the fall and winter of 1976. Several initial value model integrations of 4 months duration are carried out in order to help explain the observed anomaly development. Initial and verifying ocean data down to 400 m depth are obtained from the NORPAX ships of opportunity program. Anomalous atmospheric wind forcing is obtained from Namias: monthly mean sea-level pressure anomalies, while climatological heat fluxes are used. The skill with which the model simulates the observed anomaly evolution in the different experiments is estimated synoptically and measured statistically by calculating root mean square (RMS) temperature errors and S1 skill scores. Analysis indicates that anomalous atmospheric wind forcing improves the model predictions in the upper levels. For this particular winter case using climatological heating, however, knowledge of the initial anomalous temperature conditions does not improve the model results. The model skill at upper levels exceeds both persistence and climatology (forecast of zero anomaly) while at the lower levels it is comparable to persistence but not as good as climatology. Author (GRA)

N78-21741# Webb Inst. of Naval Architecture, Glen Cove, N.Y. Center for Maritime Studies.

WAVE MEASUREMENT AND IMPLEMENTATION ABOARD SHIP

Dan Hoffman Jul. 1977 64 p refs
(Contract MA-2-4216)
(PB-276070/0; NMRC-KP-141) Avail: NTIS HC A04/MF A01 CSCL 08C

Wave data sources from visual observation, forecasting, and direct measurement are reviewed. The application to ship operation of improved wave data aboard ship is illustrated. Shipboard wave data collected systems are evaluation. GRA

N78-21742# Washington Univ., Seattle. Dept. of Oceanography.

COASTAL UPWELLING ECOSYSTEMS ANALYSIS, DATA REPORT 39. JOINT 2: R/V THOMAS G. THOMPSON CRUISE 108 LEG 1, CTD MEASUREMENTS OFF THE COAST OF PERU NEAR CABO NAZCA, APRIL - MAY 1976

Eric D. Barton Aug. 1977 147 p Sponsored by NSF
(PB-276532/9; REF-M77-76; NSF/IDOE-77-175) Avail: NTIS HC A07/MF A01 CSCL 08J

Measurements of the depth profiles of temperature and salinity were made with a conductivity/temperature/depth probe. Computer plots of the vertical profiles of temperature, salinity and sigma-t are shown for each hydrographic station. Corresponding values of temperature, salinity, sigma-t and dynamic height anomaly are tabulated at selected depth intervals. Position, date, time and depth are also given for each station. GRA

N78-21743# Washington Univ., Seattle. Dept. of Oceanography.

COASTAL UPWELLING ECOSYSTEMS ANALYSIS, DATA REPORT 40. JOINT 2: R/V THOMAS G. THOMPSON CRUISE 108 LEGS 2 AND 3, CTD MEASUREMENTS OFF THE COAST OF PERU NEAR CABO NAZCA, MAY - JUNE 1976

M. A. Friebertshauser, D. D. Bishop, and L. A. Codispoti Aug. 1977 255 p refs
(Grants NSF OCE-76-01309; NSF OCE-76-04825)
(PB-276533/7; REF-M77-92) Avail: NTIS HC A12/MF A01 CSCL 08J

For abstract, see N78-21742.

N78-21744# State Univ. of New York, Syracuse. College of Environmental Science and Forestry.

COASTAL WETLANDS ALONG LAKE ONTARIO AND THE ST. LAWRENCE IN JEFFERSON COUNTY, NEW YORK

James W. Geis and Janet L. Kee Aug. 1977 134 p refs Sponsored in part by NOAA and New York Sea Grant Inst.
(PB-276031/2; NOAA-77111806) Avail: NTIS

HC A07/MF A01 CSCL 06F

Techniques for the location, description, and evaluation of wetland systems are considered. A system of vegetative cover description and mapping is developed for lake level-influenced wetlands along Lake Ontario and the St. Lawrence River in Jefferson County, New York. The system is applied to 41 individual wetlands or wetland segments along the shoreline using low elevation, 70 mm color aerial transparencies. A wetland map, is provided for each of these systems. By combining the area of all other wetlands greater than one acre in size with that of the wetlands in the sample series, a figure of 7742 acres of wetlands is obtained. GRA

N78-21745# Bigelow Lab. for Ocean Sciences, West Boothbay Harbor, Maine.

COASTAL UPWELLING ECOSYSTEMS ANALYSIS. DATA REPORT 41: PHYSICAL, CHEMICAL AND BIOLOGICAL OBSERVATIONS FROM JOINT 2 R/V ALPHA HELIX, LEG O, 5-20 MARCH 1976

A. E. Bass and T. T. Packard Aug. 1977 127 p refs

(Grant NSF OCE-76-01309)

(PB-276297/9; NSF/IDOE-77-173; Rept-41; Contrib-77-004) Avail: NTIS HC A07/MF A01 CSCL 08J

Investigations on Leg O were designed to test equipment and pursue studies of phytoplankton biochemistry and physiology and measure the chemical and physical properties of the air and water column before reaching the Peruvian upwelling region. The various observations, methods of collection, and analysis are described. GRA

N78-21746# Inter-American Tropical Tuna Commission, La Jolla, Calif.

COASTAL UPWELLING ECOSYSTEMS ANALYSIS. TECHNICAL REPORT 34: PHYSICAL AND BIOLOGICAL MEASUREMENTS, 29 JULY - 5 AUGUST 1973

Merritt Stevenson and Lawrence Small (Oregon State Univ., Corvallis) Jul. 1977 56 p refs

(PB-276486/8; NSF/IDOE-77-176; TR-34) Avail: NTIS HC A04/MF A01 CSCL 08A

Observations from a cruise conducted in the coastal upwelling zone off Oregon during CUE-2 where upwelling frontal interfaces are often found are presented. Changes in the concentration of phytoplankton and nutrient chemistry in and around a front were observed. The data are divided into physical and biological measurements, and drogue measurements are presented in both graphic and tabular formats. Emphasis is given to the drifting (Lagrangian) time series of physical and biological measurements data and their time changes. GRA

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N78-21747 Materials Research Labs., Melbourne (Australia).

ANTIFOULING ACTIVITY OF PHYTOTOXIC COMPOUNDS AND EXPERIMENTAL POLYMERIC ALGICIDES

R. W. Pettis, A. T. Phillip, G. C. Smith, and L. V. Wake Sep. 1977 34 p refs

(MRL-R-698; AR-000-669) Copyright. Avail: Issuing Activity

An immersion trial was carried out to examine the effect of pigment type and experimental antifouling material on the settlement of marine fouling. Three series of chlorinated rubber coatings containing various experimental and commercial phytotoxic materials were formulated and exposed. One series had a soluble pigment, another an insoluble pigment and a third had no pigment. Experimental antifouling polymers were also synthesized and immersed in coatings for comparison with the corresponding nonpolymeric materials. These polymeric coatings showed little or no antifouling performance. Author

N78-21748# Naval Research Lab., Washington, D. C.

ALGAE, ULTRAVIOLET LIGHT, AND THE PRODUCTION OF TRACE GASES Interim Report

P. J. Hannan, R. A. Lamontagne, J. W. Swinnerton, and C. Patouillet Dec. 1977 23 p refs

(AD-A049441; AD-E000097; NRL-MR-3664) Avail: NTIS HC A02/MF A01 CSCL 06/1

Algal cultures were exposed, with and without mylar films as UV absorbers, to various sunlight intensities: gas chromatographic techniques were then used to analyze the cultures for CO and C sub 1 and C sub 4 hydrocarbons. CO was the most abundant gas and its production was fostered by both high visible and UV-B intensities. When the UV-B was absorbed by mylar, even at low light intensities, there was a significant decrease in CO production. Author (GRA)

N78-21749# Institut Franco-Allemand de Recherches, St. Louis (France).

TRANSMISSION OF IMPULSE NOISE TO THE INNER EAR IN THE GUINEA PIG BY THE RECORDING OF THE INTRACOCHLEAR PRESSURE. EVALUATION OF PHENOMENA LEADING TO INJURIES [ETUDE DE LA TRANSMISSION DES BRUITS IMPULSIFS A L'OREILLE INTERNE DU COBAYE PAR ENREGISTREMENT DES VARIATIONS DE PRESSION INTRACOCHLEAIRES. ESSAI D'INTERPRETATION LESIONNELLE]

R. Franke, A. Dancer, and G. Evrard 29 Mar. 1977 38 p refs In FRENCH

(Contract DRME-76/534)

(ISL-R-103/77) Avail: NTIS HC A03/MF A01

Tests with an electrical model of the middle ear have shown that stimulation by loads similar to that of a shot can lead to an amplification by means of cochlear excitation. Direct measurements of over pressures in the cochlea of guinea pigs confirm this effect occurring at a duration of about 50 to 60 microseconds of the first positive phase of the incident air shock wave. Peak-to-peak overpressures were measured, being more than a factor 40 above the external pressure. The amplification ratio is only half for a duration of 25 or 190 microseconds. ESA

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N78-21750* + National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 178

Mar. 1978 74 p

(NASA-SP-7011(178)) Avail: NTIS HC E02 CSCL 06E

This bibliography lists 230 reports, articles, and other documents introduced into the NASA scientific and technical information system in February 1978. Author

N78-21751*# National Aeronautics and Space Administration, Washington, D. C.

WORKING IN A HOT ENVIRONMENT; PERSPIRATION LOSS; A DRINK FOR PERSONS WORKING UNDER HOT CONDITIONS, PART 2

H. Glatzel Apr. 1978 18 p refs Transl. into ENGLISH from Ther. Gegenw. (West Germany), v. 115, no. 11, 1976 p 1900-1920 Transl. by Kanner (Leo) Associates, Redwood City, Calif.

(Contract NASw-2790)

(NASA-TM-75285) Avail: NTIS HC A02/MF A01 CSCL 06S

Losses of various nutrients through sweat of persons working under hot conditions were considered. On the basis of these considerations a supplemental drink was formulated consisting of 1 liter of water per hour containing salt, potassium chloride, iron, thiamine and ascorbic acid. Author

N78-21752*# Technology, Inc., Houston, Tex. Life Sciences Div.

MICROPROCESSOR-BASED CARDIOPULMONARY MONITORING SYSTEM

[1978] 295 p refs

(Contract NAS9-14880)

(NASA-CR-151688) Avail: NTIS HC A13/MF A01 CSCL 06B

The system uses a dedicated microprocessor for transducer control and data acquisition and analysis. No data will be stored

in this system, but the data will be transmitted to the onboard data system. The data system will require approximately 12 inches of rack space and will consume only 100 watts of power. An experiment specific control panel, through a series of lighted buttons, will guide the operator through the test series providing a smaller margin of error. The experimental validity of the system was verified, and the reproducibility of data and reliability of the system checked. In addition, ease of training, ease of operator interaction, and crew acceptance were evaluated in actual flight conditions. Author

N78-21753*# Cornell Univ., New York. Rogosin Kidney Center.
SEPARATION OF LYMPHOCYTES BY ELECTROPHORESIS UNDER TERRESTRIAL CONDITIONS AND AT ZERO GRAVITY, PHASE 3 Annual Report, 1 Jan. - 31 Dec. 1977
Albert L. Rubin, Kurt H. Stenzel, Jhoong S. Cheigh, Geoffrey V. F. Seaman, and Abraham Novogrodsky 31 Dec. 1977 33 p refs
(Contract NAS9-15378)
(NASA-CR-151702) Avail: NTIS HC A03/MF A01 CSCL 06P

Electrophoretic mobilities (EPM) of peripheral lymphocytes were studied from normal subjects, chronic hemodialysis patients and kidney transplant recipients. A technique to separate B lymphocytes and null cells from non-T lymphocyte preparation was developed. The experiments were designed to determine which subpopulation of the non-T lymphocytes is primarily affected and shows a decreased EPM in chronic hemodialysis patients and kidney transplant recipients. Author

N78-21754# Civil Aeromedical Inst., Oklahoma City, Okla.
EFFECTS OF ETHANOL ON VISUAL UNIT ACTIVITY IN THE THALAMUS
A. M. Revzin Jan. 1978 10 p refs
(AD-A050922; FAA-AM-78-2) Avail: NTIS HC A02/MF A01 CSCL 06/16

The effects of ethanol on the spontaneous activity of single neurons in functionally differentiated subnuclei of a posterior thalamic visual projection area, nucleus rotundus, were studied in the anesthetized pigeon. Low doses of ethanol, 0.05 to 0.10 ml/kg, inhibited activity in anterior rotundus but had complex excitory inhibitory effects on posterior rotundal cells. Nonvisual dorsal thalamic cells, and lateral geniculate neurons were inhibited by ethanol, but threshold doses were far higher than those for the rotundal cells. These differing dose-response curves for visual and nonvisual thalamic neurons suggested that low doses of ethanol impaired peripheral visual functions; that behavioral effects of ethanol are highly dose dependent; The effects of a given dose of ethanol may vary widely and unpredictably. Author

N78-21755# Mayo Foundation, Rochester, Minn. Dept. of Physiology and Biophysics.
PROTECTION OF THE CARDIOPULMONARY SYSTEMS AGAINST THE INJURIOUS EFFECTS OF ACCELERATION Final Progress Report, 1 Jul. 1976 - 30 Sep. 1977
Peter A. Chevalier 23 Nov. 1977 50 p refs
(Contract F49620-76-C-0001)
(AD-A050142; AFOSR-78-0102TR) Avail: NTIS HC A03/MF A01 CSCL 06/16

This report describes the development of the parenchymal marker technique which makes it possible to reconstruct 3-dimensional shapes and dimensions of the heart, lung, chest-wall and diaphragm in the intact thorax. The technique presents a unique opportunity to study dynamic regional lung mechanics and lung-chest wall-diaphragm interaction under various conditions of lung volumes and body position and thereby provides the methodology to study the effects on regional lung function of alterations in these parameters induced by changes in the gravitational-inertial force environment. Significant new information has been obtained regarding regional mechanical properties of the lung with techniques possessing sufficient temporal and spatial resolution to permit quantitative determination of the dynamic changes in spatial (three-dimensional) lung parenchymal strains, regional lung volumes and lung-chest wall geometries. Such mechanical studies of the intact lung have not been possible, heretofore, these new results provide a quantitative measure of the mechanical properties of the lung under normal physiologic conditions (i.e., an intact thorax and normal intrathoracic pressures) at 1G and are required before similar studies can be performed under conditions of increased or decreased gravitational-inertial force environments encountered in aerospace flight. GRA

N78-21756# Illinois Univ. at Urbana-Champaign, Savoy. Aviation Research Lab.
HOW BIG THE MOON, HOW FAT THE EYE? Interim Report
Stanley N. Roscoe Jun. 1977 36 p refs
(Contract F44620-76-C-0009)
(AD-A050211; ARL-77-9/AFOSR-77-8; AFOSR-78-0125TR)
Avail: NTIS HC A03/MF A01 CSCL 05/8

Shifts in the apparent size and distance of real objects viewed binocularly and monocularly and of objects viewed indirectly through imaging displays are accompanied by shifts in visual accommodation distance. It is hypothesized that relaxation of accommodation toward the intermediate resting position in the absence of adequate textural cues to distance attenuates the size of the projected retinal image of more distant objects, thereby causing reductions in apparent size or increases in apparent distance, including certain types of optical illusions.
Author (GRA)

N78-21757# California Univ., Los Angeles. Dept. of Psychology.
PUPILLOMETRIC SIGNS OF BRAIN ACTIVATION VARY WITH LEVEL OF COGNITIVE PROCESSING Interim Report
Jackson Beatty and Brennis L. Wagoner 19 Jul. 1977 10 p refs Submitted for publication
(Contract N00014-76-C-0616)
(AD-A050029; TR-9) Avail: NTIS HC A02/MF A01 CSCL 05/10

The idea that hierarchically higher brain processes require greater amounts of ONS vigilance or activation for their execution was tested in two experiments measuring pupillary dilation during the decision interval of a hierarchically-structured letter-matching task. Larger dilations indicative of increased activation were observed for letter pairs requiring higher levels of processing.
Author (GRA)

N78-21758# Vermont Univ., Burlington. Dept. of Orthopaedic Surgery.
RADIOGRAPHIC AND BIOMECHANICAL STUDIES OF THE HUMAN SPINE Final Report, Jul. 1974 - Sep. 1977
M. H. Pope, D. G. Wilder, E. Buturla, R. Matteri, W. W. Frymoyer, and J. W. Frymoyer 1 Oct. 1977 150 p refs
(Grant AF-AFOSR-2738-74; AF Proj. 2312)
(AD-A049984; AFOSR-78-0063TR) Avail: NTIS HC A07/MF A01 CSCL 06/16

The techniques and equipment to take biplane and stereo roentgenographs of the spine and pelvis in various positions of flexion-extension, lateral bend and axial rotation are explained. The in vivo load-deflection characteristics are given both for the whole spine and for individual motion segments. Moire fringe topography for the back is introduced and results given. Application of these techniques to USAF ejection seats, the MAST suit and clinical measures of disc space height and rotation are reported. Measurements of the pelves of various racial groups are reported. There is discussion of interactions between the pelvis and the spine. Author (GRA)

N78-21759# California Univ., Los Angeles. Dept. of Psychology.
ACTIVATION AND SUSTAINED ATTENTION: A PUPILLOMETRIC STUDY OF AN AUDITORY VIGILANCE TASK Interim Technical Report
Jackson Beatty and Cynthia O. Wilson 1 Dec. 1977 15 p refs
(Contract N00014-76-C-0616; NR Proj. 201-207)
(AD-A050040; TR-12) Avail: NTIS HC A02/MF A01 CSCL 05/10

Using a classical auditory vigilance task, the relations between pupillometric indices of phasic central nervous system increases in activation and sustained attention were investigated. The amplitude of the task-invoked pupillary response declined as a function of time in task at a rate paralleling the performance

decrement. These findings are discussed in the context of an activation theory of attentional processes. Author (GRA)

N78-21760# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Radiology.
INVESTIGATIONS OF THE BIOLOGICAL EFFECTS OF RADIATION: A MULTI-DISCIPLINE APPROACH Progress Report, 1 Sep. 1976 - 31 Aug. 1977
H. L. Friedell 1 Sep. 1977 61 p refs
(Contract EY-76-S-02-2486)
(COO-2486-366) Avail: NTIS HC A04/MF A01

The quasi-free electron attachment rate, k/sub e/, and mobility, mu/sub e/, were studied in non-polar solutions using pulsed conductivity techniques. Measurements of k/sub e/ of greater than 50 nitro compounds in liquids have mu/sub e/ ranging from less than 0.1 to 100 sq cm/volt sec at temperatures from -100 to +40 C indicated electron dipole interactions are important in liquids having mu/sub e/ less than 1.0 sq cm/volt sec. The cellular enhancement ratio, CER, of nine of the nitro compounds were measured and a correlation between k/sub e/ and CER was found. Diffusion-controlled k/sub e/'s were observed for several carcinogens and in reversed micellar solutions. Field-dependent k/sub e/'s were measured in liquids. The mu/sub e/ of liquid C2H6 was measured and a transition from polaron to delocalized electron conduction was observed. A picosecond (ps) pulse conductivity technique was developed and hot electron and/or autoionization processes were observed in tetramethylsilane, TMS. ERA

N78-21761# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY: BIOMEDICAL AND BEHAVIORAL SCIENCES, NO. 24
10 Apr. 1978 50 p refs Transl. into ENGLISH from various RUSSIAN journals
(JPRS-70928) Avail: NTIS HC A03/MF A01

Information is reported on aerospace medicine, agrotechnology, bionics and bioacoustics, biochemistry, biophysics, environmental and ecological problems, food technology, microbiology, epidemiology and immunology, marine biology, military medicine, physiology, public health, toxicology, radiobiology, veterinary medicine, behavioral science, human engineering, psychology, psychiatry and related fields, and scientists and scientific organizations in biomedical fields. For individual titles, see N78-21762 through N78-21763.

N78-21762# Joint Publications Research Service, Arlington, Va.
COSMONAUT WORK CAPACITY IN FLIGHT
N. Fefelov *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 24 (JPRS-70928) 10 Apr. 1978 p 1-4 Transl. into ENGLISH from Krylya Rodiny (USSR), no. 1, 1978 p 26-27 (For availability see N78-21761 12-52)
Avail: NTIS HC A03/MF A01

A discussion is presented on some of the physiological and psychological conditions encountered by space flight crews and how they effect cosmonaut work capacity while in flight. Also discussed are conditioning methods to alleviate these problems. G.Y.

N78-21763# Joint Publications Research Service, Arlington, Va.
SOME PROBLEMS IN ASSESSING OCULOMOTOR ACTIVITY DURING INFORMATION RETRIEVAL
Yu. L. Trofimov, Zh. V. Levshinova, and T. M. Sycheva *In its* Transl. on USSR Sci. and Technol.: Biomed. and Behavioral Sci., No. 24 (JPRS-70928) 10 Apr. 1978 p 31-35 refs Transl. into ENGLISH from Tech. Estekika (USSR), no. 11, 1977 p 24-25 (For availability see N78-21761 12-52)
Avail: NTIS HC A03/MF A01

Using research on the readability of the display elements of motor vehicle instruments, some problems in combined processing of EOG (electrooculography) and VEOG (vector-electrooculography) are examined, as well as the nature of their dependence on the structure of the test information field. Such integral assessment of visual activity allows the correlation of the characteristics of an individual's work effectiveness (rate, precision) with the outlays of the oculomotor system, and to reveal the reasons for keeping the gaze on particular sections of the image having different information capacities. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N78-21764# Illinois Univ. at Urbana-Champaign, Savoy. Aviation Research Lab.
EVALUATION OF THE TRANSFER AND COST EFFECTIVENESS OF A COMPLEX COMPUTER-ASSISTED FLIGHT PROCEDURE TRAINER
James Patrick Finnegan Jun. 1977 133 p refs
(Contract F44620-76-C-0009)
(AD-A050413; ARL-77-7/AFOSR-77-6; AFOSR-78-0192TR)
Avail: NTIS HC A07/MF A01 CSCL 05/9

A simple, comparatively inexpensive instrument flight trainer based on computer-assisted instruction (CAI) technology was compared with more traditional training devices in teaching 48 private pilots to fly a standard instrument procedure, the holding pattern. The CAI device, based on the University of Illinois PLATO interactive computer-assisted teaching system, provided the student with instructional information and an opportunity to 'fly' holding patterns by using a hand control to input commands to the PLATO system and with reference to dynamic flight instruments displayed on the computer terminal screen. Groups of students were trained using either (1) CAI and aircraft training, (2) ground school, ground-based trainer, and aircraft training, or (3) ground school and aircraft training. All students were trained to fly both crosswind and quartering tailwind holding patterns and flew to criterion in the aircraft. Measures taken included altitude errors, inbound tracking errors, errors in inbound time, and trials to criterion. GRA

N78-21765# Illinois Univ. at Urbana-Champaign, Savoy. Aviation Research Lab.
ADAPTIVE TRAINING OF PERCEPTUAL MOTOR SKILLS: ISSUES, RESULTS AND FUTURE DIRECTIONS
Gavan Lintern and Daniel Gopher Jan. 1977 82 p refs
(Contract F44620-76-C-0009)
(AD-A050461; ARL-77-5/AFOSR-77-5; AFOSR-78-0194TR)
Avail: NTIS HC A05/MF A01 CSCL 05/9

Adaptive training research is described and evaluated. A critical examination of various experiments reveals that there is less support for the application of adaptive manipulations to applied motor skill training than is generally believed. Some apparently favorable experiments have methodological and interpretive flaws that seriously weaken their conclusions. Other experiments that provide tenable support have characteristics that are unique in adaptive training research so that the generality of their data is in doubt. The limitations of the data prevent firm conclusions being drawn about the efficiency of adaptive training. A detailed analysis of motor skill theory and research indicates that some adaptive manipulations could be effective. Methodological and conceptual issues that are critical to successfully testing those manipulations are clarified in a discussion of the adaptive training concept. Several empirical tests needed to enable a more effective analysis of adaptive training are discussed. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N78-21766# California Inst. of Tech., Pasadena.
COLLISION DETECTION AND AVOIDANCE IN COMPUTER CONTROLLED MANIPULATORS Ph.D. Thesis
Shriram Mahabal Udupa 14 Sep. 1976 236 p refs
Avail: NTIS HC A11/MF A01

The problem of planning safe trajectories for computer controlled manipulators with two links and multiple degrees of freedom was examined. A model was developed for collision detection and avoidance systems for such manipulators. The justification for the model lies in the computer implementations for 2D and 3D manipulator systems. These systems incorporate a significant portion of the model. The promising performance of the implementation makes fast collision avoiders a distinct possibility. The solution presented treats manipulators with a sliding joint, and permits the manipulator to transport objects which can be enclosed within the minimum bounding cylinder of the manipulator link. Modifications of the solution that permit handling of large objects are indicated. An extension of the solution that solves the problem for manipulators with only rotary joints is described. Author

N78-21767*# Clemson Univ., S.C. Dept. of Mechanical Engineering.
DYNAMIC HYPERFILTRATION MEMBRANES FOR HIGH-TEMPERATURE SPACECRAFT WASH WATER RECYCLE Final Report
J. L. Gaddis and C. A. Brandon Feb. 1978 134 p refs
(Contract NAS9-13669)
(NASA-CR-151689; T-932-5-2) Avail: NTIS HC A07/MF A01 CSCL 06K

The effect of operating parameters on the performance of the hyperfiltration membrane when operating on washwater was examined. The parameters were pressure, temperature, velocity, and concentration. Data taken included rejections of organic materials, ammonia, urea, and an assortment of ions. The membrane used was a dual layer, polyacrylic acid over zirconium oxide, deposited in situ on a porcelain ceramic substrate. Author

N78-21768# Civil Aeromedical Inst., Oklahoma City, Okla.
AIRCREW AND PASSENGER PROTECTIVE BREATHING EQUIPMENT STUDIES
D. DeSteiguer, M. S. Pinski, J. R. Bannister, and E. B. McFadden Jan. 1978 46 p refs
(AD-A051002; FAA-AM-78-4) Avail: NTIS HC A03/MF A01 CSCL 06/11

A collection of various reports are presented, concerning the protective capability of passenger and crew oxygen breathing equipment and specialized devices and concepts against smoke and toxic gases produced by aircraft fires. Author

N78-21769# Army Aeromedical Research Lab., Fort Rucker, Ala.
HELMET COLD CONDITIONING: CORRELATION OF STRUCTURAL TEMPERATURES IN ACTUAL AND SIMULATED COLD ENVIRONMENTS
John C. Johnson and Stanley C. Knapp Oct. 1977 26 p ref
(AD-A050033; USSARL-78-4) Avail: NTIS HC A03/MF A01 CSCL 06/17

An experiment was conducted at the US Army Aeromedical Research Laboratory, USAARL, to correlate the helmet thermal characteristics found in cold temperature conditioning as required by current impact test methodologies (American National Standards Institute (ANSI) Standard Z90.1 and the Department of Transportation (DOT) Motor Vehicle Safety Standard (MVS) No. 218, Motorcycle Helmet 49CSR571.218) and the thermal characteristics which occur during actual use by the wearer in a cold environment. Four types of helmets were used in this evaluation: sling suspension, form-fit, standard motorcycle, and short motorcycle helmets. Temperatures were taken within the helmet structure using thermocouples at the following locations: on top of the exterior surface of the shell, at the interface between the shell and the crushable liner, at the center of the crushable and at the center of the comfort liner. Standard helmet impact test methodologies do not simulate potential, real world, cold climate conditions. The standard impact test methodologies are inappropriate for the determination of cold temperature dynamic response of a helmet system. GRA

N78-21770# Air Force Human Resources Lab., Brooks AFB, Tex.
VISUAL-PROPRIOCEPTIVE CUE CONFLICTS IN THE CONTROL OF REMOTELY PILOTED VEHICLES Final Report, Jul. 1973 - Apr. 1977
Lawrence E. Reed Sep. 1977 32 p refs
(AD-A049706; AFHRL-TR-77-57) Avail: NTIS HC A03/MF A01 CSCL 05/8

The purpose of this experiment was to investigate operator performance in an environment which was conducive to visual-proprioceptive conflict. More specifically, the intent was to determine the relative ability of pilot, navigator, and nonrated Air Force officer groups to maneuver a simulated remotely piloted vehicle (RPV) from a simulated airborne control station (i.e., a mother ship). The vehicle and/or the station were given gust-like disturbances on pitch and/or roll. In a between-groups design, the performance of the three groups of subjects was compared under two conditions of conflict (e.g., visual roll right and roll left motion; visual roll right and pitch-up motion), nonconflict, motion only, and no motion. To maintain adequate performance, it was necessary for the subjects to disregard sensations of motion. The results revealed that the two conditions of conflict engendered the highest proportion of control errors (i.e., reversal, and axis errors) by all subjects, regardless of experience, but pilots tended to make more errors than nonpilots. The past experience of pilots did not help them overcome the effects of conflict as measured by control errors, but it did help them reduce response latencies. Motion cues appear to play not only an alerting role, but also provide information on the direction of attitude changes. This research indicated no advantage of training pilots, as opposed to nonpilots, to perform airborne control of RPVs as represented by the conditions of this experiment. Such training should be conducted in the presence of motion cues. Author (GRA)

N78-21771# Illinois Univ. at Urbana-Champaign, Savoy. Aviation Research Lab.
HUMAN PERFORMANCE IN AVIATION SYSTEMS Final Scientific Report, 15 Jul. 1975 - 30 Jun. 1977
Charles O. Hopkins Jul. 1977 55 p refs
(Contract F44620-76-C-0009)
(AD-A050078; ARL-77-14/AFOSR-77-12; AFOSR-78-0080TR) Avail: NTIS HC A04/MF A01 CSCL 05/9

Activities and accomplishments are summarized for six research tasks involving various aspects of human performance in the operation of aviation systems. The program has produced information relevant both to the selection and training of pilots and the design of systems and operational procedures. Topics included are: (1) attention, timesharing, and pilot performance; (2) transfer of computer assisted learning to flight; (3) computer assisted decision training for air combat tactics; (4) Acquisition and transfer of aircraft landing skills through manipulation of the augmented cue structure; (5) synergistic displays for complex navigation and control tasks; and (6) perceived size and distance as correlates of visual accommodation. GRA

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering.*

N78-21772 Northwestern Univ., Evanston, Ill.
OPTIMAL CONTROL OF A STORAGE SYSTEM Ph.D. Thesis
Paulo Renato DeMorais 1977 77 p
Avail: Univ. Microfilms Order No. 78-00734

The input process was assumed to be a stochastic process having nondecreasing right continuous paths of the pure jump type, with finitely many jumps in any finite interval with probability one, with a nonstationary, content dependent jump rate and jump size distribution. The release rate function was assumed to be nonstationary and content dependent. It was shown that the content process was a strong Markov process and its weak infinitesimal generator was derived. Dissert. Abstr.

N78-21773# Army Electronics Command, Fort Monmouth, N. J. Communications and Automatic Data Processing Lab.
COMPUTER FAMILY ARCHITECTURE SELECTION COMMITTEE. VOLUME 3: EVALUATION OF COMPUTER ARCHITECTURE VIA TEST PROGRAMS Final Research and Development Technical Report
William E. Burr, Samuel H. Fuller (Carnegie-Mellon Univ.), Paul S. Shaman (Carnegie-Mellon Univ.), and David A. Lamb (Carnegie-Mellon Univ.) Sep. 1977 141 p refs
(DA Proj. 1L7-62701-AH-92)
(AD-A049482; ECOM-4528-Vol-3) Avail: NTIS
HC A07/MF A01 CSCL 09/2

This volume presents the evaluation of the Computer Family Architecture (CFA) candidate machines via a set of test programs. The measures used to rank the computer architectures were S, the size of the test program, and M and R, two measures designed to estimate the principle components contributing to the nominal execution speed of the architecture. The S, M, and R measurements are discussed in detail in this report, but the following numbers are the most important, summary results of our evaluation process. These results are the composite performance of the candidate architectures for the set of 12 test programs specified by the CFA committee. Each test program was coded from two to four times on each architecture to minimize the effect of programmer variability. Analysis of variance procedure was used to determine the overall relative performance of the three computer architectures. GRA

N78-21774# Army Electronics Command, Fort Monmouth, N. J. Center for Tactical Computer Sciences.
COMPUTER FAMILY ARCHITECTURE SELECTION COMMITTEE. VOLUME 4: ARCHITECTURAL RESEARCH FACILITY ISP DESCRIPTION, SIMULATIONS, DATA COLLECTION Final Research and Development Technical Report
M. Barbacci (Naval Underwater Systems Center, Newport, R. I.), Robert Gordon (Naval Underwater Systems Center, Newport, R. I.), Rosemary Howbrigg (NRL, Washington, D. C.), Daniel Siewiorek (Carnegie-Mellon Univ.), and Susan Zuckerman (Carnegie-Mellon Univ.) Sep. 1977 220 p refs
(DA Proj. 1L7-62701-AH-92)
(AD-A049483; ECOM-4529-Vol-4) Avail: NTIS
HC A10/MF A01 CSCL 09/2

This volume describes the process of automatically gathering architectural data from the benchmark programs. Formal descriptions of the candidate architectures were written and run under a simulator. Assembly listings of the benchmark programs were used to generate simulation command files containing absolute code. These command files were then used to initialize the simulated memory. The result of the simulated benchmarks were collected into a data base for post-processing. Automating the data collection process not only eliminated tedious and potentially error prone hand calculations, but also provided the means to gather dynamic program behavior information that would be almost impossible to calculate manually. Author (GRA)

N78-21775# Army Electronics Command, Fort Monmouth, N. J. Communications and Automatic Data Processing Lab.
COMPUTER FAMILY ARCHITECTURE SELECTION COMMITTEE. VOLUME 5: PROCEDURE FOR AND RESULTS OF THE EVALUATIONS OF SOFTWARE BASES OF THE CANDIDATE ARCHITECTURES FOR THE MILITARY COMPUTER FAMILY Final Research and Development Technical Report
E. Lieblein, J. Wagner (Mass. Univ., Amherst), H. Stone (Naval Underwater Systems Center, Newport, R. I.), J. Rodrigues (Softech, Inc.), and A. Clearwaters Sep. 1977 116 p
(DA Proj. 1L7-62701-AH-92)
(AD-A049484; ECOM-4530-Vol-5) Avail: NTIS
HC A06/MF A01 CSCL 09/2

One of the primary reasons for adopting the architecture of an existing successful computer family as the architecture for a future Military Computer Family is the potential utility of the existing support software base. As such, the evaluation of the amount of support software for each of the three finalist architectures was deemed to constitute a very important factor in the overall selection process. This paper details the software evaluation process utilized as well as the quantitative results of that process. Author (GRA)

N78-21776# Army Electronics Command, Fort Monmouth, N. J. Center for Tactical Computer Systems.
COMPUTER FAMILY ARCHITECTURE SELECTION COMMITTEE. VOLUME 6: LIFE CYCLE COST MODELS Final Report
Aaron H. Coleman, William Svirsky, Allen T. Irwin, Thomas Giles, John J. Cornyn (NRL), and W. R. Smith (NRL) Sep. 1977 110 p refs
(AD-A049487; ECOM-4535-Vol-6) Avail: NTIS
HC A06/MF A01 CSCL 09/2

This report describes the mathematical information, input data, and results of a methodology and two life-cycle requirements models for comparing computer architectures with respect to life-cycle costs: the Top Down (TD) model and the Bottom-Up (BU) model. The methodology and models were formulated to help the Army and Navy select a single computer architecture for a software-compatible family of military computers for the 1980's. Three candidate architectures were compared: The IBM System/370, the Digital Equipment Corporation PDP-11, and the Interdata 8/32. GRA

N78-21777# Army Electronics Command, Fort Monmouth, N. J.
COMPUTER FAMILY ARCHITECTURE SELECTION COMMITTEE. VOLUME 8: CFA FINAL SELECTION Final Report
Allan Clearwaters (Naval Underwater Systems Center), Robert Gordon (Naval Underwater Systems Center), and Daniel Siewiorek (Carnegie-Mellon Univ.) Sep. 1977 18 p
(AD-A049485; ECOM-4531-Vol-8) Avail: NTIS
HC A02/MF A01 CSCL 09/2

The Computer Family Architecture (CFA) final selection process was divided into four phases: (1) Data Review. Data developed by the CFA Selection Committee in connection with initial absolute/quantitative criteria, architecture test results, support software evaluation, licensing terms/conditions and life cycle cost analyses were reviewed and summarized. (2) Manufacturer's Presentation. Representatives of each finalist were invited to give brief presentations about future plans for their architecture. Questions from the Committee probed areas of concern. (3) Discussion. The discussion centered around contributing factors, both pro and con, to the selection of each architecture. (4) Summation. Each Architecture Subcommittee chairman provided a summation of the case for selection of his architecture. GRA

N78-21778# Army Electronics Command, Fort Monmouth, N. J.
COMPUTER FAMILY ARCHITECTURE SELECTION COMMITTEE. VOLUME 9: A CONSIDERATION OF ISSUES IN THE SELECTION OF A COMPUTER FAMILY ARCHITECTURE Final Report
Thomas Conrad (Naval Underwater Systems Center), Robert Estell (Fleet Combat Direction Systems Support Activity), and Leonard

Haynes (Naval Ship Research and Development Center) Sep. 1977 23 p refs
(AD-A049486; ECOM-4532-Vol-9) Avail: NTIS HC A02/MF A01 CSCL 09/2

This volume describes various issues confronted by the Computer Family Architecture (CFA) Selection Committee in its search for a standard military computer architecture. This discussion of issues reveals the difficult nature of the Committee's task. Further, it demonstrates the sources of the Committee's confidence in its final recommendations. The motivation for including this data in the final Committee report derives from the Committee's experience in bringing new Committee members 'up to speed' and in describing progress to non-participants. Invariably, newcomers raised questions with which the Committee had already dealt at length. Eleven issues of premise and thirteen issues of procedure are discussed in detail. Each issue is presented as a question. Its significance is discussed and the impact of the Committee's decision relevant to the issue is described. The decision of the Committee is stated and supporting rationale provided. Author (GRA)

N78-21779# Army Electronics Command, Fort Monmouth, N. J.
COMPUTER FAMILY ARCHITECTURE SELECTION COMMITTEE. VOLUME 2: SELECTION OF CANDIDATE ARCHITECTURES AND INITIAL SCREENING Final Report
William E. Burr, Samuel H. Fuller, and Harold Stone Sep. 1977 54 p refs
(DA Proj. 1L7-62701-AH-92)
(AD-A049457; ECOM-4527) Avail: NTIS HC A04/MF A01 CSCL 09/2

The selection of initial candidate computer architectures to be evaluated by the CFA Committee was begun with letters from NRL and ECOM to 21 Navy and 15 Army commands, laboratories, system centers, and project managers, soliciting proposals for candidate architectures. These inquiries were followed by discussions at the first two CFA meetings and resulted in an initial set of nine computer architectures: (1) AN/GYK-12, (2) AN/UYK-7, (3) AN/UYK-20, (4) Burroughs 6700, (5) Data General NOVA (ROLM-1664), (6) IBM System/370, (7) DEC PDP-11, (8) SEL 32, and (9) Interdata 8/32. In order to begin the evaluation process and reduce the number of candidate architectures for more intensive examination and benchmarking, a set of absolute and quantitative criteria were developed. The result of this initial ranking and screening process was to narrow the list of candidates to three machines. GRA

N78-21780# Defense Communications Engineering Center, Reston, Va.
AN EVALUATION OF DATA INFORMATION TRANSFER REQUIREMENTS FOR THE FUTURE DCS
K. G. Kelley Nov. 1977 53 p refs
(AD-A049464; AD-E100019; DCEC-TN-24-77) Avail: NTIS HC A04/MF A01 CSCL 17/2

To perform telecommunications design effectively, a data base of user requirements for ADP generated information transfer must be developed. There is little commonality of data transfer characteristics among many existing ADP systems that use telecommunications transfer of data. Therefore, the problems of telecommunication of data are numerous, and a growing need for additional capability is foreseen. To provide this telecommunications capability, existing and future data transfer needs must be identified and characterized, and this report is intended to provide insight into the problem. Author (GRA)

N78-21781# Army Electronics Command, Fort Monmouth, N. J. Center for Tactical Computer Sciences.
COMPUTER FAMILY ARCHITECTURE SELECTION COMMITTEE Summary Report
William E. Burr, Aaron H. Coleman, and William R. Smith (NRL) Sep. 1977 31 p
(AD-A049466; ECOM-4525) Avail: NTIS HC A03/MF A01 CSCL 09/2

An Army/Navy Computer Family Architecture CFA Selection Committee, comprising ten Army and seventeen Navy Organizations was organized by the Naval Research Laboratory and the Army Electronics Command in 1975 to select a proven, well-known computer architecture to be the basis of a Military Computer Family MCF. The Selection Committee met five times in the period between October, 1975, and August, 1976 and evaluated nine computer architecture candidates in accordance with criteria established by the Committee. The Committee applied a preliminary screening process to select three candidates IBM S/370, DEC PDP-11, and Interdata 8/32 for more intensive evaluation. This final evaluation process considered experimentally determined architectural efficiency, support software availability, life cycle cost, and architecture licensing. As a result of this process, the Committee ranked the three architecture finalists. GRA

N78-21782# Army Electronics Command, Fort Monmouth, N. J.
COMPUTER FAMILY ARCHITECTURE SELECTION COMMITTEE. VOLUME 1: INTRODUCTION Final Report
William E. Burr, Aaron H. Coleman, and William R. Smith Aug. 1977 25 p
(DA Proj. 1L7-62701-AH-92)
(AD-A049468; ECOM-4526) Avail: NTIS HC A02/MF A01 CSCL 09/2

The Computer Family Architecture (CFA) Selection Committee was formed to evaluate computer architecture candidates for the purpose of selecting one as the basis for a family of software-compatible military computers. The military spends billions yearly for developing computer systems for tactical and strategic applications. The proliferation of incompatible computer instruction sets aggravates the problems of software development maintenance, documentation and training. A demonstrated approach to mitigating this problem is for the military to adopt a well-known, proven instruction-set architecture which can be implemented in advanced technologies as a family of software-compatible computers. Important benefits of this approach include open competition among military computer vendors to build CFA computers using their own hardware production techniques and the availability of a large, mature set of software development tools and associated programmer expertise. In pursuit of the CFA goals, a joint Army/Navy effort instituted to select a CFA and develop a Military Computer Family (MCF) using the CFA. An Army/Navy Selection Committee representing 10 Army and 17 Navy organizations was formed to evaluate and select architectures for the CFA. The CFA Selection Committee Final Report (Volumes 2 through 9) describes the work of the Selection Committee performed over the period October 1975 through August 1976. Author (GRA)

N78-21783# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
NOTES FOR A MODEL OF HUMAN PERFORMANCE IN ZOG Interim Report
Allen Newell 5 Aug. 1977 30 p refs
(Contracts F44620-73-C-0074; N00014-76-C-0874)
(AD-A049532; AFOSR-78-0032TR) Avail: NTIS HC A03/MF A01 CSCL 05/8

This paper contains some initial considerations for how to analyze human performance using ZOG. A brief introduction to ZOG will be given as seen at the level of the user, in order to make this paper minimally self contained. The paper referenced above, which introduces ZOG and describes the system architecture, should be consulted for more background. GRA

N78-21784# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
A SURVEY OF COMPUTER ARCHITECTURES FOR IMAGE PROCESSING AND PATTERN RECOGNITION Interim Report
N. S. Ramesh and K. S. Fu Nov. 1977 48 p refs
(AD-A049536; TR-EE77-38; AFOSR-78-0015TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper surveys many of the proposed computer architectures for image processing such as array processors, associative processors, and optical processors. An attempt is made to compare the merits and demerits of these architectures. Attention is specially focussed on array architectures such as the CLIP system which may be economically implemented by large scale integrated circuits (LSI). In section 2 a set of the more commonly used image processing operations is presented which represent a

minimum useful repertoire of operations which should be efficiently executable on an image processor. Author (GRA)

N78-21785# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
L-STAR: AN INTERACTIVE, SYMBOLIC IMPLEMENTATION SYSTEM Interim Report
A. Newell, D. McCracken, and G. Robertson 3 Oct. 1977 56 p refs
(Contract F44620-73-C-0074; ARPA Order 2466)
(AD-A050119; AFOSR-78-0116TR) Avail: NTIS MF A01 CSCL 09/2

L-star is a system for building software systems. The design of L-star stresses features not found in many other implementation languages or systems: it is interactive rather than compiler based, it has a symbol manipulation language embedded in it, it is highly extensible, and it allows for total accessibility to both the underlying hardware and the L-star system itself. This paper describes the design philosophy of L-star, the mechanisms used to implement it, the experiences had in using it, and some unresolved issues it still presents. GRA

N78-21786# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
PROCEEDINGS OF THE 1ST ANNUAL ROCKY MOUNTAIN SYMPOSIUM ON MICROCOMPUTERS: SYSTEMS, SOFTWARE, ARCHITECTURE Final Report, 1 Jun. 1977 - 31 May 1978
Michael Andrews and Steve McCormick 2 Sep. 1977 317 p refs Symp. held at Fort Collins, Colo., 31 Aug. - 2 Sep. 1977
(Grant AF-AFOSR-3367-77)
(AD-A049559; AFOSR-78-0017TR) Avail: NTIS HC A14/MF A01 CSCL 09/2

The Rocky Mountain symposia on microcomputers are organized as a forum for presentation and discussion of basic research in the field of microcomputers. The aim is to encourage a broad base of interaction between the industrial, governmental, and academic communities, thus providing guidance and feedback for the directions of basic research and for the effective implementation of research achievements. Author (GRA)

N78-21787# Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.
COMPLETING THE REQUIREMENTS SET AS A MEANS TOWARDS BETTER DESIGN FRAMEWORKS: A FOLLOW-UP EXERCISE IN SOFTWARE ARCHITECTURAL DESIGN
Rafael C. Andreu and Stuart E. Madnick Dec. 1977 89 p refs
(Contract N00039-77-C-0255)
(AD-A049782; CISR-P010-01-06; CSIR-TR-4) Avail: NTIS HC A05/MF A01 CSCL 09/2

The design methodology investigated in this project is applied to the requirements set resulting from the addition of new requirements to the set used previously. This exercise permits testing the robustness of the methodology and the identification of a more comprehensive DBMS design framework. Guidelines for completing the requirements set are discussed and the methodology application described. Finally, a unified methodology framework is presented and a number of areas for further research identified. GRA

N78-21788# Air Force Systems Command, Wright-Patterson AFB, Ohio.
A CONTROL SYSTEM FOR DEPICTING INFORMATION FROM COMPUTER ON AN ELECTROLUMINOPHORIC PLATE
J. Zierke and M. Dydynski 19 Aug. 1977 8 p Transl. into ENGLISH from Patent (Poland), no. 73568, 20 Apr. 1973 p 1-2
(AD-A049394; FTD-ID(RS)T-1326-77) Avail: NTIS HC A02/MF A01 CSCL 09/2

The object of this invention is a control system for depicting information from computer on an electroluminophoric plate. The application of electroluminophoric plates for depicting information from a computer is not yet known. The aim of this invention is to enable depicting information from computer in real time systems onto electroluminophoric plates through the development of a control system which would accept information from a computer and transfer it onto electroluminophoric plate. This aim has been achieved through the development of a control system to depict information from computers onto an electroluminophoric plate attached to the computer in place of a perforator. The control system according to this invention is composed of an intermediate block, control block, and commutation block of feeding (charging) the luminophoric plate. The control block contains a matching (adjusting) block and the register of rows and columns, which is connected with decoder of rows and with the decoder of columns. The decoders and regulation block of excitation time are connected in series with the commutation system of charging the electroluminophoric plate. GRA

N78-21789# Los Alamos Scientific Lab., N. Mex.
SCIENTIFIC CALCULATING SYSTEM WITH A NUMBER-ORIENTED MICROPROCESSOR SEQUENCED BY A SINGLE COMPONENT MICROCOMPUTER
C. Dwayne Ethridge and Gary M. Worth 1977 5 p refs Presented at the Nucl. Sci. Symp., San Francisco, 19-21 Oct. 1977
(Contract W-7405-eng-36)
(LA-UR-2383; Conf-771023-5) Avail: NTIS HC A02/MF A01

A scientific calculating system for large distributed-task processing systems and for small isolated intelligent data acquisition and instrumentation systems was established with a number-oriented microprocessor sequenced by a single component microcomputer. A MOS/LSI number-oriented microprocessor provided the scientific calculating capability with Reverse Polish Notation data entry. Input data sequencing, computation processing, intermediate result comparison, answer feedback to master processors is controlled by a single component microcomputer. Author

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N78-21790 Stanford Univ., Calif.
MOTIVATION AND INTENSIONALITY IN A COMPUTER SIMULATION MODEL Ph.D. Thesis
William Simmons Faught, III 1977 189 p
Avail: Univ. Microfilms Order No. 7802156

The behavior of a patient participating in a psychiatric interview by answering questions, introducing its own topics, and responding to negatively valued situations was modeled. The focus of this work was on the motivational mechanisms required to investigate and direct the modelled behavior. The major components of the model are: (1) a production system formalism accounting for the instigation and guidance of behavior as a function of internal and external environmental factors; (2) a model of affects as an anticipation mechanism based on a small number of basic pain-pleasure factors; and (3) a formalism for intensional behavior requiring a dual representation of symbol and concept. Issues of intelligence, psychopathological modelling, and artificial intelligence programming were also discussed. Dissert. Abstr.

N78-21791*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLOWNET: A COMPUTER PROGRAM FOR CALCULATING SECONDARY FLOW CONDITIONS IN A NETWORK OF TURBOMACHINERY
James R. Rose Mar. 1978 68 p refs
(NASA-TM-73774; E-9579) Avail: NTIS HC A04/MF A01 CSCL 09B

The program requires the network parameters, the flow component parameters, the reservoir conditions, and the gas properties as input. It will then calculate all unknown pressures and the mass flow rate in each flow component in the network. The program can treat networks containing up to fifty flow components and twenty-five unknown network pressures. The types of flow components that can be treated are face seals, narrow slots, and pipes. The program is written in both structured

FORTRAN (SFTRAN) and FORTRAN 4. The program must be run in an interactive (conversational) mode. Author

N78-21792*# Martin Marietta Corp., Denver, Colo.
THERMAL RADIATION ANALYSIS SYSTEM (TRASYS 2), PROGRAMMER'S MANUAL
Robert J. Connor, Ronald E. Paulson, Richard G. Goble, and Carl L. Jensen Jun. 1977 300 p
(Contract NAS9-14318)
(NASA-CR-151686; MCR-74-107-Rev-1) Avail: NTIS HC A13/MF A01 CSCL 09B

TRASYS, the Thermal Radiation Analysis System, is a digital computer software system with a generalized capability to solve the radiation-related aspects of thermal analysis problems. When used in conjunction with a generalized thermal analysis program such as the Systems Improved Numerical Differencing Analyzer (SINDA) program, any thermal problem that can be expressed in terms of a lumped parameter, radiation conductor thermal network can be solved. The function of TRASYS is twofold. It provides: 1) Internode radiation interchange data; 2) Incident and absorbed heat rate data from environmental radiant heat sources. Data of both types are provided in a format directly usable by the thermal analyzer programs. Author

N78-21793# TRW Defense and Space Systems Group, Redondo Beach, Calif.
IMPROVEMENTS TO SEMANOL, VOLUME 1 Final Technical Report, May 1976 - May 1977
Paul T. Berning Griffiss AFB, N. Y. RADC Nov. 1977 64 p 4 Vol.
(Contract F30602-76-C-0238)
(AD-A049472; RADC-TR-365-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 09/2

This report describes the work that was performed in meeting the goals of this contract provides a brief introduction to the semanol method, and discusses issues in formal semantic description that arose in performing these tasks. This project accomplished the definition of an improved semantic specification metalanguage, semanol 76 corollary upgrading of the interpreter program to process the new metalanguage substantial improvement of the processing efficiency of this new semanol interpreter implementation of a powerful new user command language for the semanol 76 interpreter writing of a comprehensive formal specification of the Jovial J3 programming language and presentation of a three-day course in the use of semanol 76. The effectiveness of the semanol system was greatly improved as a result of this work. In addition, a basis for control of the Jovial J3 programming language was established by production of a formal specification of Jovial J3. Semanol 76 can now be a useful working tool in the USAF Higher Order Language Control Facility. GRA

N78-21794# TRW Defense and Space Systems Group, Redondo Beach, Calif.
SEMANOL (76) REFERENCE MANUAL, VOLUME 2 Final Technical Report
F. C. Belz Griffiss AFB, N.Y. RADC Nov. 1977 126 p
(Contract F30602-76-C-0238)
(AD-A049473; RADC-TR-77-365-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 09/2

SEMANOL(76) is a metaprogramming language designed specifically for use in writing formal, operational, specifications of the syntax and semantics of contemporary programming languages. The SEMANOL(76) reference manual provides a detailed description of the metaprogramming language. The context-free syntax is given in the SEMANOL(76) notation, while the context-sensitive constraints and semantics are given by prose text. This manual does not explain how SEMANOL(76) ought to be used when writing formal specifications. Author (GRA)

N78-21795# TRW Defense and Space Systems Group, Redondo Beach, Calif.
SEMANOL (76) SPECIFICATION OF JOVIAL (J3), VOLUME 3 Final Technical Report
Frank C. Belz and Ira M. Green Griffiss AFB, N.Y. RADC Nov. 1977 372 p
(Contract F30602-76-C-0238)
(AD-A049474; RADC-TR-77-365-Vol-3) Avail: NTIS HC A16/MF A01 CSCL 09/2

This report contains a formal specification of the JOVIAL (J3) programming language. The formal specification is written in TRW's SEMANOL(76) metalanguage, and so is a specification given in operational (i.e., interpretive) terms. The specification is generally complete and extremely detailed. This level of detail is unavoidable if JOVIAL(J3) semantics are to be comprehensively treated, as was done here. It also results from producing a specification that can actually produce operational results. However, by having an operational form of specification, it was possible to test the JOVIAL(J3) specification through use of the SEMANOL(76) interpreter program. This testing insured the syntactic correctness of the entire metaprogram, and that much of the semantics yielded correct results for inputs of varying complexity. Author (GRA)

N78-21796# TRW Defense and Space Systems Group, Redondo Beach, Calif.
SEMANOL (76) INTERPRETER DOCUMENTATION, VOLUME 4 Final Technical Report
Eric R. Anderson and Dennis M. Heimbigner Griffiss AFB, N.Y. RADC Nov. 1977 39 p
(Contract F30602-76-C-0238)
(AD-A049475; RADC-TR-77-365-Vol-4) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report describes the internal organization of the SEMANOL(76) interpreter program, operational upon the Multics computer system, and provides instructions on the use of the program. The SEMANOL(76) interpreter program is a processor of metaprograms written in the SEMANOL(76) metalanguage (i.e., it executes SEMANOL(76) metaprograms); these metaprograms are ordinarily formal definitions of object programming languages. Author (GRA)

N78-21797# Washington Univ., Seattle. Dept. of Mathematics.
USE OF FLOYD'S ALGORITHM TO FIND SHORTEST RESTRICTED PATHS
Victor Klee and David Larman Sep. 1977 24 p refs
(Contract N00014-67-A-0103-0003)
(AD-A049467; TR-62) Avail: NTIS HC A02/MF A01 CSCL 12/2

In a directed network with no negative circuit, Floyd's algorithm finds, for each pair of nodes x and y, a shortest path from x to y. Here the procedure is extended to minimize more general length functions over sets of paths that are restricted in various ways. GRA

N78-21798# Stanford Univ., Calif. Systems Optimization Lab.
A HYBRID APPROACH TO MULTI-STAGE LINEAR PROGRAMS
James K. Ho and John A. Tomlin (Inst. for Advanced Computation) Sep. 1977 14 p refs
(Contracts N00014-75-C-0865; DAAG29-74-C-0034; EY-76-S-03-0326; Grant NSF MCS-76-20019)
(AD-A049477; SU-SOL-77-27) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper presents a hybrid algorithm for multi-stage linear programs arising from time-phased or dynamic models. The hybrid computation is based on a nested decomposition algorithm and the revised simplex method. Initial computational experience is reported. Author (GRA)

N78-21799# Maryland Univ., College Park. Computer Science Center.
PDP 11 IMAGE PROCESSING SOFTWARE
Kenneth C. Hayes, Jr., Martin Herman, and Russell Smith Dec. 1977 61 p refs
(Contract DAAG53-76-C-0138; ARPA Order 3206)
(AD-A049586; TR-612) Avail: NTIS HC A04/MF A01 CSCL 09/2

The implementation of two different image handling systems for use on PDP 11/45 minicomputers is documented. Micro-XAP is an image access facility for UNIX FORTRAN users. Virtual Arrays are a more general image access facility for UNIX LISP users. This report serves as a user's guide for users who will interact with Micro-XAP or Virtual Arrays. Author (GRA)

N78-21800# Maryland Univ., College Park. Computer Science Center.

THINNING ALGORITHMS FOR GRAYSCALE PICTURES

C. R. Dyer and Azriel Rosenfeld Nov. 1977 13 p refs

(Contract DAAG53-76-C-0138; ARPA Order 3206)

(AD-A049587; TR-610) Avail: NTIS HC A02/MF A01 CSCL 09/2

Elongated black objects in black-and-white pictures can be 'thinned' to arcs and curves, without changing their connectedness, by (repeatedly) deleting black border points whose deletion does not locally disconnect the black points in their neighborhoods. This technique 'generalizes that two points are 'connected' if there is a path joining them on which no point is lighter than either of them. It is then possible to 'thin' dark objects by changing each point's gray level to the minimum of its neighbors' gray levels, provided this does not disconnect any pair of points in its neighborhood. Examples illustrating the performance of this technique are given. Author (GRA)

N78-21801# Maryland Univ., College Park. Computer Science Center.

ITERATIVE HISTOGRAM MODIFICATION, 2

Shmuel Peleg Nov. 1977 11 p refs

(Contract DAAG53-76-C-01; ARPA Order 3206)

(AD-A049588; TR-606) Avail: NTIS HC A02/MF A01 CSCL 09/2

Histogram peaks can be sharpened using an iterative process in which large bins grow at the expense of nearby smaller bins. The modified histogram will consist of a few spikes corresponding to the peaks of the original histogram. The image corresponding to the modified histogram is often almost indistinguishable from the original image. The small number of different gray levels in that image can be used to facilitate compressing or segmenting it. Author (GRA)

N78-21802# Maryland Univ., College Park.

A NOTE ON THE USE OF LOCAL MIN AND MAX OPERATIONS IN DIGITAL PICTURE PROCESSING

Yasuo Nakagawa Oct. 1977 21 p refs

(Contract DAAG53-76-C-0138; ARPA Order 3206)

(AD-A049589; TR-590) Avail: NTIS HC A02/MF A01 CSCL 09/2

Shrinking and expanding operations on two-valued digital pictures are useful for noise removal, as well as for detecting dense regions and elongated parts of objects. For grayscale pictures, the analogs of shrinking and expanding are local MIN and MAX operations. These operations commute with thresholding; thus if they are applied to a grayscale picture, followed by thresholding, the result is the same as if the picture were first thresholded and shrinking and expanding were then performed. Applying MIN and MAX operations prior to thresholding thus makes it possible to defer the choice of a threshold, which may be easier to select after these operations have been performed. Author (GRA)

N78-21803# Maryland Univ., College Park. Computer Science Center.

ALGORITHMS AND HARDWARE TECHNOLOGY IMAGE RECOGNITION Semiannual Report, 1 May - 31 Oct. 1977

Nov. 1977 27 p refs

(Contract DAAG53-76-C-0138; DARPA Order 3206)

(AD-A049590; SAR-3) Avail: NTIS HC A03/MF A01 CSCL 17/5

The research activities summarized in this report relate to the development of algorithms of automatic target cueing in FLIR imagery. Topics covered include preprocessing and feature extraction (noise cleaning, edge detection); using image models to predict the outputs of thresholding and edge detection operations; segmentation and postprocessing (variable thresholding, adaptive quantization, thinning, recursive segmentation); and classification. GRA

N78-21804# Stanford Univ., Calif. Dept. of Operations Research.

A FURTHER INVESTIGATION OF EFFICIENT HEURISTIC PROCEDURES FOR INTEGER LINEAR PROGRAMMING WITH AN INTERIOR

Frederick S. Hillier Feb. 1977 65 p refs

(Contracts N00014-76-C-0418; DAAC29-74-C-0034; F44620-74-C-0079)

(AD-A049593; SU-TR-72; SU-TR-13) Avail: NTIS HC A04/MF A01 CSCL 12/1

This paper presents the results of an extensive investigation of algorithmic heuristic procedures for general pure integer linear programming problems having only inequality constraints. Included are a number of promising new variations and extensions of the procedures previously proposed by the author. Extensive computational experimentation has largely succeeded in identifying a flexible package of the most effective approaches, ranging from a very fast streamlined procedure to a very powerful combination of procedures. These procedures are both extremely efficient (comparable to the simplex method) and very effective in identifying good solutions (often obtaining an optimal one). Although they are designed primarily for dealing algorithmically with the frequently encountered problems that are too large to be computationally feasible for exact algorithms, they also can be valuable on smaller problems by quickly providing an advanced starting solution for such algorithms. Author (GRA)

N78-21805# Washington Univ., Seattle. Arctic Ice Dynamics Joint Experiment Office.

AN ALTERNATIVE METHOD FOR A GLOBAL ANALYSIS OF QUADRATIC PROGRAMS IN A FINITE NUMBER OF STEPS

Andre F. Perold Nov. 1977 12 p refs

(Contracts N00014-75-C-0267; N00014-75-C-0865; EY-76-5-03-0326; Grants NSF MCS-76-20019; NSF MCS-76-81259)

(AD-A049756; SOL-77-30) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper considers the global analysis of general quadratic programs in a finite number of steps. A procedure is presented for recursively finding either the global minimum or a halfline of the constraint set along which the minimand is unbounded below. Author (GRA)

N78-21806# Stanford Univ., Calif. Systems Optimization Lab.

AT THE INTERFACE OF MODELING AND ALGORITHMS RESEARCH

G. B. Dantzig and S. C. Parikh Oct. 1977 24 p refs

(Contracts N00014-75-C-0865; EY-76-S-03-0326; Grant NSF MCS-76-20019)

(AD-A049757; SU-SOL-77-29) Avail: NTIS HC A02/MF A01 CSCL 12/2

This paper looks at the efforts of the PILOT Modeling Group and the Solution Methods Group and provides a presentation that describes some of the synergistic interactions that permit each effort to benefit in a substantive way from the day-to-day problems and the accompanying experience of the other. These efforts are beginning to complement in an important way the essential research activity of the other. Areas covered include model modifications in the PILOT System brought about by the computational realities and an outline of the work on testing algorithms for solving large-scale systems using PILOT. GRA

N78-21807# Naval Postgraduate School, Monterey, Calif.

MULTICRITERIA INTEGER ZERO-ONE PROGRAMMING: A TREE-SEARCH TYPE ALGORITHM M.S. Thesis

Aggelos Konstantinou Simopoulos Dec. 1977 47 p refs

(AD-A050244) Avail: NTIS HC A03/MF A01 CSCL 12/1

An algorithm for zero-one integer programming problems with more than one objective functions is developed, implemented and tested. For a multiobjective problem the notion of optimality must be replaced with that of efficiency. A solution is said to be efficient if it satisfies the constraints and no other solution satisfying them scores as well with respect to all objective functions and better with respect to at least one of them. In the presented algorithm, the problem variables are partitioned into two sets; those whose coefficients in the objective functions are all of the same sign, and the remainder. A tree search implicit enumeration algorithm based on this partition is developed and computational results are presented. Author (GRA)

N78-21808# Wright State Univ., Dayton, Ohio. Dept. of Administrative Science and Finance.

MULTI-ITEM SCHEDULING IN REPARABLE ITEM INVENTORY SYSTEMS WITH REFLECTION PROGRAMMING Interim Report
W. Steven Demmy Apr. 1977 39 p refs
(Grant AF-AFOSR-3011-76; AF Proj. 2304)
(AD-A049553; AFOSR-77-1293TR; WP-76-3011-4) Avail: NTIS HC A03/MF A01 CSCL 15/5

The repair and overhaul of military equipment is a costly and complex logistics activity. Factors that may have significant impact upon scheduling decisions in such systems include costs of set-up, production, and expediting, obsolescence probabilities, the availability of the reparable assets, manpower, equipment and funds required to support the repair effort. This paper reviews the current state-of-the-art for solving multi-item repair scheduling problems in such systems, and presents an algorithm for solving these problems using Generalized Upper Bounding with dynamic programming subproblems. Computational experience involving up to 170 items, 48 constraints, and 12 planning periods is also reported. Author (GRA)

N78-21809# Wright State Univ., Dayton, Ohio. Dept. of Administrative Science and Finance.
ALGORITHMS FOR COMPUTING REPAIR SCHEDULES IN PROBABILISTIC ENVIRONMENTS Interim Report
W. Steven Demmy Apr. 1977 32 p refs
(Grant AF-AFOSR-3011-76; AF Proj. 2304)
(AD-A049554; AFOSR-77-1294TR; WP-76-3011-03) Avail: NTIS HC A03/MF A01 CSCL 15/5

This paper considers an organization that repairs or overhauls a single type of complex equipment such as aircraft transmitters, navigational computers, or electrical generating units. The organization inventories the repaired assets to meet probabilistic demands for serviceable items. Additional serviceable stocks may also be purchased from outside vendors if the repair process does not satisfy all demands. The paper considers the problem of computing jointly optimal procurement and repair schedules for such a system. Cost elements explicitly considered include set-up costs, learning curve effects, expediting and inventory holding costs, and penalties for incurring shortages or for modifying the schedule from previously established levels. Multi-period lead times, obsolescence and time-discounting effects are also considered. GRA

N78-21810# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
RESEARCH IN NATURAL LANGUAGE UNDERSTANDING Quarterly Technical Progress Report, 1 Sep. - 30 Nov. 1977
W. A. Woods and R. J. Brachman Dec. 1977 86 p refs
(Contract N00014-77-C-0378; ARPA Order 3414)
(AD-A049781; BBN-3742; QTPR-1) Avail: NTIS HC A05/MF A01 CSCL 09/2

The goals of this project are to develop techniques required for fluent and effective communication between a decision maker and an intelligent computerized display system in the context of complex decision tasks such as military command and control. This problem is approached as a natural language understanding problem, since most of the techniques required would still be necessary for an artificial language designed specifically for the task. Characteristics considered important for such communication are the ability for the user to omit detail that can be inferred by the system and to express requests in a form that 'comes naturally' without extensive forethought or problem solving. These characteristics lead to the necessity for a language structure that mirrors the user's conceptual model of the task and the equivalents of anaphoric reference, ellipsis, and context-dependent interpretation of requests. These in turn lead to requirements for handling large data bases of general world knowledge to support the necessary inferences. The project is seeking to develop techniques for representing and using real world knowledge in this context, and for combining it efficiently with syntactic and semantic knowledge. This report gives an initial specification of the knowledge representation system being used. GRA

N78-21811# Aerospace Corp., El Segundo, Calif. Engineering Science Operations.
A GRADIENT PROJECTION-MULTIPLIER METHOD FOR NONLINEAR PROGRAMMING
John T Betts 30 Jan. 1978 43 p refs
(Contract F04701-77-C-0078)
(AD-A049864; TR-0078(3451-10)-1; SAMSO-TR-78-5) Avail: NTIS HC A03/MF A01 CSCL 12/1

This report describes a gradient projection-multiplier method for solving the general nonlinear programming problem. The algorithm poses a sequence of unconstrained optimization problems which are solved using a new projection-like formula to define the search directions. The unconstrained minimization of the augmented objective function determines points where the gradient of the Lagrangian function is zero. Points satisfying the constraints are located by applying an unconstrained algorithm to a penalty function. New estimates of the Lagrange multipliers and basis constraints are made at points satisfying either a Lagrangian condition or a constraint satisfaction condition. The penalty weight is increased only to prevent cycling. The numerical effectiveness of the algorithm is demonstrated on a set of test problems. Author (GRA)

N78-21812# Office of the Project Manager Selected Ammunition, Dover, N. J.
A COMPUTER PROGRAM FOR SOLVING LEARNING CURVE PROBLEMS Final Report
Louis M. Smith Dec. 1977 43 p
(AD-A049917; PMSA-2-6) Avail: NTIS HC A03/MF A01 CSCL 05/10

Report describes a computer program for solving Learning Curve problems. Program is written in FORTRAN 4, and is terminal/user interactive. Typical problems solved are lot Mid-Points, First Unit Costs, Total and specific lot costs, learning slopes and first unit cost from raw lot data, and a what-if segment that predicts lot sizes. The program also provides some instruction for the user to enable proper usage. Author (GRA)

N78-21813# Science Applications, Inc., McLean, Va.
SOFTWARE ENGINEERING. VOLUME 1: ITS DEVELOPMENT AND STANDARDS Final Report
Jan. 1978 113 p refs
(Contract DACA88-76-C-0010; DA Proj. 4A7-62725-AT-11)
(AD-A049869; CERL-TR-E-126-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 09/2

This report presents the findings of a study to evaluate the maturity of the software development process and its accompanying standards, project future development in the field, and to identify areas needing standards and the means for achieving the required standardization. The report examines development as a generic process to provide a perspective for describing the evolution and present state of software engineering. The purpose and contributions of standards in development are defined and described. Analysis of software engineering's evolution to date indicates that it is still in the active, experimental stages of its evolution, in which it is forming the elements of principle and practice on which its mature character will be built. An analysis of the phases of the development cycle in terms of their required inputs and the availability and applicability of standards for these inputs indicated that most procedures and inputs to software engineering are not now standardized. Thirteen specific areas requiring standards were identified. This study attempts to present a systematic approach to software standards and to raise national awareness of the need for and benefits to be derived from improved software standards. GRA

N78-21814# Stanford Univ., Calif. Artificial Intelligence Lab.
SYNTHESIS: DREAMS YIELD PROGRAMS
Zohar Manna and Richard Waldinger Nov. 1977 102 p refs
(Contracts N00014-75-C-0816; N00014-76-C-0687; MDA903-76-C-0206; NR Proj. 049-389; NR Proj. 049-378; ARPA Order 2494)
(AD-A049761; STAN-CS-77-630; AIM-302) Avail: NTIS HC A06/MF A01 CSCL 09/2

Deductive techniques are presented for deriving programs systematically from given specifications. The specifications express the purpose of the desired program without giving any hint of the algorithm to be employed. The basic approach is to transform the specifications repeatedly according to certain rules, until a satisfactory program is produced. The rules are guided by a number of strategic controls. These techniques have been incorporated in a running program synthesis system, called DEDALUS. The DEDALUS system accepts specifications expressed in a high-level language, including set notation,

logical quantification, and a rich vocabulary drawn from a variety of subject domains. The system attempts to transform the specifications into a recursive, LISP-like target program. Over one hundred rules have been implemented, each expressed as a small program in the QLISP language. GRA

N78-21815# Bureau of Reclamation, Denver, Colo. Engineering and Research Center.
AN ASSEMBLY-LANGUAGE MINICOMPUTER SOFTWARE DEVELOPMENT SYSTEM
T. R. Whittemore Oct. 1977 23 p
(PB-276108/8; REC-ERC-77-12) Avail: NTIS HC A02/MF A01 CSCL 09B

Problems of designing a memory resident software development system for use with minicomputers are presented. A combination editor and assembler program is described; a user's guide is included. Conversion of the assembler into a cross-assembler is discussed. GRA

N78-21816# Oak Ridge National Lab., Tenn. Computer Sciences Div.
PLOT USER'S MANUAL
S. J. Lynch and J. A. Holmes Sep. 1977 71 p refs
(Contract W-7405-eng-36)
(ORNL/CSD/TM-41) Avail: NTIS HC A04/MF A01

A plotting routine (PLOT) currently available on the Livermore Time-Sharing System, uses dd80 calls to produce standard x-y plots and contour plots with one user call. The contour plots can be in Cartesian or polar coordinates. Although PLOT has no provisions for general contour plotting, the user can define his own coordinate system if he so chooses. PLOT creates graphic output having a good appearance, and provides axes, labeling, scaling, and positioning. A vector plotter is also available in PLOT. This easily used subroutine has options for multiple curves on one plot or multiple plots on one page. PLOT (in LRLTRAN source code) is available on the 7600 in FILEM area 24730.SUE PLOT. ERA

N78-21817# Argonne National Lab., Ill. Applied Mathematics Div.
MINKIT: AN OPTIMIZATION SYSTEM
Larry Nazareth May 1977 26 p refs
(Contract W-7405-eng-38)
(ANL-AMD-TM-305) Avail: NTIS HC A03/MF A01

A set of ideas which have to do with organizing and developing optimization algorithms and software is described. These ideas were embodied in an optimization system currently being developed. Minkit is a collection of driver algorithms, modules, and testing aids for general unconstrained optimization, nonlinear least squares, and the solution of systems of nonlinear equations. ERA

62 COMPUTER SYSTEMS

Includes computer networks.

N78-21818 Washington Univ., Seattle.
A NEW APPROACH TO COMPUTER AIDED TRANSIENT ANALYSIS OF STIFF LINEAR NETWORKS Ph.D. Thesis
Ramesh Manghanmal Wadhwani 1977 145 p
Avail: Univ. Microfilms Order No. 7732565

A new parameter, termed the bandwidth compression parameter (BWCP) to deal with large bandwidth networks is reported. Also , a shifting parameter (SP) has been analyzed and it is shown that it can be usefully employed to handle ill effects of dominant poles close to the s-plane imaginary axis. This parameter permits larger frequency steps than are possible with conventional methods, resulting in a greater numerical efficiency for systems with a wide range of time constants. The use of the BWCP provides a substantial savings in computing time, reduced storage requirements and exact control over the truncation error resulting from the use of the finite Fourier transform. Dissert. Abstr.

N78-21819# National Bureau of Standards, Washington, D. C. Inst. for Computer Sciences and Technology.
PERFORMANCES ASSURANCE AND DATA INTEGRITY PRACTICES Final Report
Robert L. Patrick and Robert P. Blanc Jan. 1978 57 p refs
Prepared in cooperation with Patrick (Robert L.), Northridge, Calif.
(PB-276400/9; NBS-SP-500-24; LC-77-608309) Avail: NTIS HC A04/MF A01 CSCL 09B

This report identifies the approaches and techniques now practiced for detecting, and when possible, correcting malperformance as it occurs in computer information systems. This report is addressed to two audiences: to the systems designer using stock commercial hardware and software who is creating a system which will tax the available hardware, software, or staff skills; and to the manager who wishes to chronicle the deficiences in an existing system prior to improvement. It enumerates 67 items of current practice which prevent computer malperformance. GRA

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N78-21820# Maryland Univ., College Park. Computer Science Center.
A NOTE ON THE USE OF SECOND-ORDER GRAY LEVEL STATISTICS FOR THRESHOLD SELECTION Interim Report
Narendra Ahuja and Azriel Rosenfeld Sep. 1977 17 p refs
(Grant AF-AFOSR-3271-77)
(AD-A049454; TR-572; AFOSR-78-0014TR) Avail: NTIS HC A02/MF A01 CSCL 09/4

The gray level histogram of an image is commonly used as an aid in selecting thresholds for segmenting the image. Various methods have been proposed to make threshold selection easier. This note describes a class of such methods that make use of second-order gray level statistics to define improved histograms. Author (GRA)

N78-21821# Brown Univ., Providence, R. I. Div. of Engineering.
ON MINIMUM ENERGY CONTROL OF COMMUTATIVE BILINEAR SYSTEMS Interim Report
K. C. Wei and A. E. Pearson Dec. 1977 16 p refs
(Grant AF-AFOSR-2793-75)
(AD-A049500; AFOSR-78-0025TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A minimum energy control problem is considered for commutative bilinear systems with and without terminal constraints. Optimal controls are shown to be constant vectors determined by the boundary conditions. Sufficient conditions are derived for uniqueness of the optimal control in the absence of a terminal constraint. A class of physical bilinear systems is discussed which possess the commutative property. Author (GRA)

N78-21822# Brown Univ., Providence, R. I. Div. of Engineering.
A DOUBLE INTEGRAL QUADRATIC COST PROBLEM WITH APPLICATION TO FEEDBACK STABILIZATION Interim Report
W. H. Kwon and A. E. Pearson Nov. 1977 23 p refs
(Grant AF-AFOSR-2793-75)
(AD-A049533; AFOSR-78-0021TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper considers an optimal regulator problem which is different from the conventional linear quadratic cost problem but leads to a stable linear feedback control. The problem considers a double integral quadratic cost function and an integral constraint on state trajectories. The optimal open-loop control is transformed to a closed-loop control and subsequently a modified control is obtained based on a receding horizon notion. This modified control law is shown to be asymptotically stable and to result in a new method for stabilizing linear time-varying systems, as well as providing an easy means to stabilize time-invariant systems.

Moreover, the gain matrix for the modified control is obtained from a Riccati-type equation over a finite time interval, and a large class of nonlinearities can be allowed in the closed-loop without destroying its stability. GRA

N78-21823# Maryland Univ., College Park. Computer Science Center.

CLUSTERING EDGE VALUES FOR THRESHOLD SELECTION

David L. Milgram and Martin Herman Dec. 1977 24 p refs
(Contract DAAG53-76-C-0138; ARPA Order 3206)
(AD-A049592; CSC-TR-617) Avail: NTIS HC A02/MF A01 CSCL 06/4

Thresholds may be chosen for images containing several object classes by clustering thinned edge points in a 2-D histogram, whose axes represent gray level value and edge value. Each such edge cluster suggests its average gray level as a threshold. Interior clusters may also be defined as representatives of object class interiors. The relation of edge clusters to interior clusters gives rise to a classification strategy based on partitioning the 2-D histogram into disjoint regions labelled as to object class. Each partition is a classification domain for points of the original gray level image. GRA

N78-21824# Stanford Univ., Calif. Dept. of Operations Research.

OPTIMAL DISPATCHING OF A FINITE CAPACITY SHUTTLE

Rajat K. Deb 15 Nov. 1977 27 p refs
(Contract N00014-76-C-0418; Grant NSF ENG-75-14847)
(AD-A049595; SU-TR-77; SU-TR-47) Avail: NTIS HC A03/MF A01 CSCL 12/1

The problem of determining the optimal operating policy of a two terminal shuttle with fixed capacity Q less than or equal to infinity is considered. The passengers arrive at each terminal according to Poisson processes and are transported by a single carrier operating between the terminal. The interterminal travel time is a positive random variable with finite expectation. Under a fairly general cost structure, it is shown that the policy which minimizes the expected total discounted cost over infinite time horizon has the following form: Suppose the carrier is at one of the terminals with x number of waiting passengers and suppose that y number of passengers are waiting at the other terminal. Then the optimal policy is to dispatch the carrier if and only if x greater than or equal to infinity is considered. The passengers arrive at each terminal according to Poisson processes and are transported by a single carrier operating between the terminals. The interterminal travel time is a positive random variable with finite expectation. Under a fairly general cost structure, it is shown that the policy which minimizes the expected total discounted cost over infinite time horizon has the following form: Suppose the carrier is at one of the terminals with x number of waiting passengers and suppose that y number of passengers are waiting at the other terminal. Then the optimal policy is to dispatch the carrier if and only if x greater than or equal to G(y), where G(y) is a monotone decreasing control function. Furthermore, G(y) is always less than or equal to the carrier capacity Q. This control function can be approximated by the linear functions G(y) = K-Beta y. Author

N78-21825# Harris Corp., Melbourne, Fla. Electronic Systems Div.

DIGITAL IMAGERY TEST SET Final Technical Report, Jun. 1976 - Jun. 1977

Rufus H. Cofer, Jr. Griffiss AFB, N. Y. RADC Nov. 1977 284 p refs
(Contract F30602-76-C-0296; AF Proj. 6244)
(AD-A049798; RADC-TR-77-371) Avail: NTIS HC A13/MF A01 CSCL 09/4

This exploratory development provides the initial concepts for a digital imagery test set from which subsequent detailed specifications would result. The difficult questions of image evaluation and quality were explored with the following categories of performance suggested for the test set criteria; amplitude response, frequency response, geometric fidelity, and noise. Both subjective tests with an experienced photointerpreter and objective tests using test pattern concepts were made. Computer programs were generated to simulate digital imagery degradations for the subjective tests, and these programs could be extended to include sensor simulations. The use of Moire patterns provided simple objective tests as a result of the array structure of 2 dimensional digital imagery. Further development is recommended in exploring the tradeoffs between MTF response and aliasing distortion. Author (GRA)

N78-21826# Maryland Univ., College Park. Computer Science Center.

MOSAIC MODELS FOR IMAGE ANALYSIS AND SYNTHESIS Interim Report

Narendra Ahuja Oct. 1977 48 p refs
(Grant AF-AFOSR-3271-77)
(AD-A050100; TR-607; AFOSR-78-0127TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report is concerned with a class of models for natural images that treat an image as a mosaic, composed of patches generated by a random geometric process. These models are contrasted with conventional statistical image models. Proposed applications of such models in image analysis and synthesis are discussed. Author (GRA)

N78-21827# Naval Postgraduate School, Monterey, Calif.

CMS HISTOGRAM, DENSITY ESTIMATION AND PROBABILITY PLOTTING ROUTINES, WITH AN APPLICATION TO THE ANALYSIS OF THE OUTPUT OF ASSIMULATION OF A CORRELATED QUEUE M.S. Thesis

Georgios Ioannis Danikas Dec. 1977 233 p refs
(AD-A050213) Avail: NTIS HC A11/MF A01 CSCL 09/2

The object of this thesis has been twofold. The first object was to develop FORTRAN versions of several existing APL programs which were designed to analyze univariate data. In particular the programs were designed to test for exponentiality and normality of the data and, by sectioning or jackknifing, obtain estimates of sampling variances of sample moments. The second object of the thesis was to use these programs in a simulation study of first-come first-served queues in which the service times and the inter-arrival times are exponentially distributed but dependent. The dependence is introduced by using the mixed moving average autoregressive structure (EARMA (p, q)) for exponential sequences. Four models of correlated queues are introduced, giving autocorrelated and cross-correlated service and arrival times in various degrees. The simulation study gives a quantitative idea of the effect of correlation on the mean waiting time and the distribution of the waiting time. GRA

N78-21828# Wisconsin Univ., Madison. Mathematics Research Center.

THE LANDAU PROBLEM FOR MOTIONS ON CURVES

I. J. Schoenberg Nov. 1977 48 p refs
(Contract DAAG29-75-C-0024)
(AD-A049492; MRC-TSR-1809) Avail: NTIS HC A03/MF A01 CSCL 12/1

If a particle moves with bounded acceleration on a bounded section of a straight line, then its velocity is bounded. The choice of acceleration and starting position and velocity required to achieve this velocity is a simple problem in control theory. A generalization of the problem is presented to the case where a curve was given in a plane, and a maximum allowable value was given for the acceleration of a particle moving on the curve. It turns out that then the magnitude of the velocity of the particle is bounded by a certain function of position on the curve. Author

N78-21829# Kansas Univ., Lawrence. Dept. of Mathematics.

STOCHASTIC FILTERING AND CONTROL Interim Report

Tyrone E. Duncan Nov. 1977 7 p refs
(Grant AF-AFOSR-3177-77)
(AD-A049992; AFOSR-78-0043TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Some stochastic filtering problems for continuous process in manifolds have been solved and necessary and sufficient conditions for an optimal control of a continuous stochastic system in a sphere bundle have been obtained. Author (GRA)

N78-21830# Northwestern Univ., Evanston, Ill. Dept. of Mechanical Engineering and Astronautical Sciences.

MULTICRITERIA OPTIMIZATION WITH UNCERTAINTY IN

THE DYNAMICS Interim Report
W. E. Schmitendorf 1977 10 p refs
(Grant AF-AFOSR-2923-76)
(AD-A049541; AFOSR-78-0024TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Optimal control problems with a vector performance index and uncertainty in the state equations are investigated. It is assumed that nature chooses the uncertainty, subject to bounds, to maximize the performance index which the controller attempts to minimize. Using Pareto optimality as the optimality criterion, sufficient conditions for an optimal solution are presented. The conditions also suggest a technique for determining the optimal control. The results are illustrated with an example.

Author (GRA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N78-21831 Stanford Univ., Calif.
EXTREMAL PROBLEMS IN QUASICONFORMAL MAPPINGS WITH SIDE CONDITIONS Ph.D. Thesis
Donald Keith Krecker 1977 131 p refs
Avail: Univ. Microfilms Order No. 78-02187

Real valued functionals were defined on classes of K-quasiconformal mappings of a fixed domain, and extrema of the functions were sought using a method of variations. The technique produced a partial differential equation for the extremal mapping, together with boundary conditions. A subclass of a class of K-quasiconformal mappings was defined by requiring that certain functionals vanish, and the constrained extremal problem of maximizing another functional over the subclass is posed. Using variations within the subclass and a theorem of the alternative from the field of linear programming, a method of solution using Lagrange multipliers was justified. An example of the use and calculation of Lagrange multipliers was given. Dissert. Abstr.

N78-21832 Oklahoma State Univ., Stillwater.
ESTIMATION AND HYPOTHESIS TESTING FOR GENERALIZED MULTIVARIATE ANALYSIS OF COVARIANCE MODELS Ph.D. Thesis
Samuel Patton Caudill 1977 138 p
Avail: Univ. Microfilms Order No. 7801222

The standard analysis applicable to a full multivariate analysis of covariance model can be performed in the presence of missing covariates by using a generalization of the analysis of covariance technique. It was shown that best asymptotic normal estimators of the design and regression parameters and test statistics which are asymptotically distributed as chi-square variables can be obtained for a multivariate analysis of covariance model with missing observations among the dependent and/or independent variables. The conclusions of this study are based on optimal large sample properties and so it is difficult to assess the small properties of the estimators and test procedures without simulation experiments. A general computer program is described which will compute best asymptotic normal estimators and perform tests of hypotheses for multivariate analysis of covariance data with missing dependent and/or independent variables.

Dissert. Abstr.

N78-21833 Florida Univ., Gainesville.
STABILITY OF AN INFINITE SYSTEM OF DIFFERENTIAL EQUATIONS Ph.D. Thesis
Yong Yoon, Joon 1977 64 p
Avail: Univ. Microfilms Order No. 7725964

Qualitative properties (boundedness, stability, etc.) of solutions of dynamical systems, described by infinite-systems of differential equations, are discussed. Explicit results are obtained for a special class of systems, denoted by (S), which describe the process of dissociation of polymer molecules into smaller units. The limit case of an infinite system of such equations is studied to understand the limit behavior of very large systems. The positivity property of (S) is proved: if every component of the initial condition is nonnegative, then the solution of (S) remains nonnegative componentwise. The stability property of (S). This is done by using a Liapunov function in the framework of Hale. The result of the investigation covers a general case which goes beyond the physical interpretation of (S). That is, solutions of (S) have the property of stability in I sub 1. The same result is also derived by a direct argument using Barbalat's Lemma. Finally, in the appendix the approximation of the solutions for (S) is discussed. Dissert. Abstr.

N78-21834 California Univ., San Diego.
DISCRETE VARIATIONAL TECHNIQUES IN FINITE MATHEMATICS Ph.D. Thesis
Michelle Lynn Wachs 1977 143 p
Avail: Univ. Microfilms Order No. 7732845

Problems of minimizing the cost of binary and ternary trees and on minimizing the cost of a certain type of partition of a rectangle are considered. Discrete variational techniques are employed in treatment of both problems. A new algorithm for constructing minimum cost binary trees in O(n log n) time is presented. The method used can be easily applied to ternary trees to obtain results analogous to the binary tree results. These results provide interesting information about minimum cost ternary trees. However, they do not make it possible for a minimum cost ternary tree algorithm to be obtained. A variational technique is also used to solve the problem of partitioning (in a certain manner) a rectangle into a fixed number of rectangles of equal area, so that the total length of the boundaries is minimum. A closed form solution of this problem is obtained. Dissert. Abstr.

N78-21835 State Univ. of New York, Buffalo.
CONTRIBUTIONS TO THE DIMENSIONAL THEORY Ph.D. Thesis
Jun Terasawa 1977 50 p
Avail: Univ. Microfilms Order No. 7832708

Topics in the dimension theory are discussed. The contributions go in two directions. A modification of delta is introduced, called inverse delta having almost all of the important properties of delta, such as ind = 0, complete metrizability and ind = dim = 1. However, the main result presented in this direction is the proof that dim inverse delta squared = dim delta squared = 1 under the continuum hypothesis: thus, it is impossible to obtain the above mentioned space X just by squaring delta or inverse delta. The second direction deals with the dimension theory of completely regular spaces. Two union theorem, which hold for normal spaces X, are disproved. The results are obtained by investigating the Stone-Cech remainders of Mrowka's spaces N union R. Dissert. Abstr.

N78-21836 Wyoming Univ., Laramie.
BOOLEAN ALGEBRAS WITH PARTITIONING BASES Ph.D. Thesis
Jerald Duane Bope 1977 34 p
Avail: Univ. Microfilms Order No. 7800165

A partitioning basis for a Boolean algebra is a basis for the algebra which has the properties: (1) the basis contains 1, but not 0; and (2) p and q are elements of the basis. There may be infinitely many nonisomorphic Boolean algebras with the same partitioning basis, but there is only one Boolean algebra (up to isomorphism) such that the partitioning basis, without the unit, is irredundant; that Boolean algebra arises naturally from the poset structure of the basis. If the partial order on a partitioning basis is such that a certain type of chain is finite, then the partitioning basis can be reduced to an irredundant partitioning basis. Define a denumerable Boolean algebra to have the atom-property, if the algebra modulo the idea generated by its atoms is the denumerable, atomless Boolean algebra.

Dissert. Abstr.

N78-21837 Saint Louis Univ., Mo.
LAPAC: A COMPUTER PACKAGE FOR SOLVING THE LAPLACE TRANSFORM Ph.D. Thesis
Michael William Kappel 1977 182 p
Avail: Univ. Microfilms Order No. 7800502

When the Laplace transform is expressed as the ratio of two polynomials P(s)/Q(s), the problem of inverting the Laplace transform becomes one of finding the roots of the polynomial in the denominator of the fraction. There are then known formulae for calculating the inverse of the Laplace transform. A computer package was developed to solve the problem, with a higher

rate of success than other existing computer packages. The benefit of such a package was inherent in the vast amount of time that would be saved. The computer packages was composed of five programs. These five programs carry out the work of inverting the Laplace transform. APPROX approximates a Laplace transform as the ratio of two polynomials P(s)/Q(s). A modification of an approximation technique due to Akin is used in APPROX.
Dissert. Abstr.

N78-21838*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
DESIGN OF A COMPENSATION FOR AN ARTMA MODEL OF A DISCRETE TIME SYSTEM M.S. Thesis
Carlos I. Mainemer Feb. 1978 99 p refs
(Grant NGL-22-009-124)
(NASA-CR-156097; ESL-R-803) Avail: NTIS HC A05/MF A01 CSCL 12A

The design of an optimal dynamic compensator for a multivariable discrete time system is studied. Also the design of compensators to achieve minimum variance control strategies for single input single output systems is analyzed. In the first problem the initial conditions of the plant are random variables with known first and second order moments, and the cost is the expected value of the standard cost, quadratic in the states and controls. The compensator is based on the minimum order Luenberger observer and it is found optimally by minimizing a performance index. Necessary and sufficient conditions for optimality of the compensator are derived. The second problem is solved in three different ways; two of them working directly in the frequency domain and one working in the time domain. The first and second order moments of the initial conditions are irrelevant to the solution. Necessary and sufficient conditions are derived for the compensator to minimize the variance of the output. Author

N78-21839*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
AN EFFICIENT ALGORITHM FOR CHOOSING THE DEGREE OF A POLYNOMIAL TO APPROXIMATE DISCRETE NONOSCILLATORY DATA
David R. Hedgley Apr. 1978 8 p ref
(NASA-TM-72854; H-1010) Avail: NTIS HC A02/MF A01 CSCL 12A

An efficient algorithm for selecting the degree of a polynomial that defines a curve that best approximates a data set was presented. This algorithm was applied to both oscillatory and nonoscillatory data without loss of generality. Author

N78-21840*# Mississippi State Univ., State College.
ELLIPTIC SYSTEMS AND NUMERICAL TRANSFORMATIONS
C. Wayne Mastin and Joe F. Thompson 25 May 1976 21 p refs
(Contract NAS1-14101)
(NASA-TM-79433; Rept-76-14) Avail: NTIS HC A02/MF A01 CSCL 12A

Properties of a transformation method, which was developed for solving fluid dynamic problems on general two dimensional regions, are discussed. These include construction error of the transformation and applications to mesh generation. An error and stability analysis for the numerical solution of a model parabolic problem is also presented. Author

N78-21841*# Houston Univ., Tex. Dept. of Mathematics.
ON Nth ROOTS OF POSITIVE OPERATORS
D. R. Brown and M. J. OMalley Feb. 1978 7 p refs
(Contract NAS9-15000)
(NASA-CR-151697; Rept-68) Avail: NTIS HC A02/MF A01 CSCL 12A

A bounded operator A on a Hilbert space H was positive. These operators were symmetric, and as such constitute a natural generalization of nonnegative real diagonal matrices. The following result is thus both well known and not surprising: A positive operator has a unique positive square root (under operator composition). Author

N78-21842*# Houston Univ., Tex. Dept. of Mathematics.
THE NUMERICAL EVALUATION OF MAXIMUM-LIKELIHOOD ESTIMATES OF THE PARAMETERS FOR A MIXTURE OF NORMAL DISTRIBUTIONS FROM PARTIALLY IDENTIFIED SAMPLES Final Report
Homer F. Walker Jun. 1976 218 p refs
(Contract NAS9-15000)
(NASA-CR-151699; Rept-54) Avail: NTIS HC A10/MF A01 CSCL 12A

Likelihood equations determined by the two types of samples which are necessary conditions for a maximum-likelihood estimate were considered. These equations suggest certain successive approximations iterative procedures for obtaining maximum likelihood estimates. The procedures, which are generalized steepest ascent (deflected gradient) procedures, contain those of Hosmer as a special case. Author

N78-21843# Lockheed Missiles and Space Co., Palo Alto, Calif.
STATISTICAL ANALYSIS OF A FORECASTING MODEL USING ONE-DIMENSIONAL NONLINEAR TRANSFORMATIONS
E. F. Iurkov [1977] 6 p refs Transl. into ENGLISH of the book "Raspoznavanie Obrazov" Moscow, Nauka, 1977 p 17-22
Avail: NTIS HC A02/MF A01; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The forecast of a scalar quality r according to a forecasting method based on using one dimensional nonlinear transformations is sought according to the criterion of the least squares in the form f(X) = z (the sum to I terms, one for each positive integer from 1 to I, times phi sub i, times x sub i), where X = (x sub 1, ... x sub I) is the vector of the forecasting variables, and z and phi sub i are one dimensional monotonic functions to be determined by sampling of experimental results. The advantage of the model over simpler forecasting methods is evaluated in applications to problems of medical and seismological forecasting. Author

N78-21844# Texas A&M Univ., College Station. Dept. of Mathematics.
SYSTEMS OF GENERALIZED ABEL INTEGRAL EQUATIONS WITH APPLICATIONS TO SIMULTANEOUS DUAL RELATIONS Interim Report
J. R. Walton 1977 35 p refs
(Grant AF-AFOSR-3290-77)
(AD-A049446; AFOSR-77-1304TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

A method is presented for solving certain systems of generalized Abel integral equations by constructing equivalent singular integral equations and their corresponding Riemann boundary value problems. An application is then given to a class of simultaneous dual relations of a type arising in bimedia fracture problems in elasticity and viscoelasticity. The equations discussed in this paper are a generalization of those considered earlier. GRA

N78-21845# Maryland Univ., College Park. Computer Science Center.
REDUCTION OF A LARGE POLYNOMIAL MATRIX TO SMITH-NORMAL-FORM BY UNIMODULAR BLOCK-PARTITIONING TRANSFORMATION
E. V. Krishnamurthy 1977 22 p refs
(Grant AF-AFOSR-3271-77)
(AD-A049453; TR-594; AFOSR-78-0013TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A block-partitioning scheme based on unimodular transformations is suggested for the reduction of a large polynomial matrix to Smith Normal Form. This technique when implemented with the finite field computational procedure will be useful for the direct spectral factorization of the rational polynomial matrix arising in the solution of the Wiener-Hopf integral equation for the design of optimal filters for random processes. Author (GRA)

N78-21846# California Univ., Los Angeles. Dept. of Mathematics.
BOUNDARY-DEPENDENT STABILITY CRITERIA FOR DIFFERENCE APPROXIMATIONS OF HYPERBOLIC PROBLEMS, 1 Interim Report
Moshe Goldberg and Eitan Tadmor 1977 28 p refs
(Grant AF-AFOSR-3046-76)

(AD-A049501; AFOSR-78-0027TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

One-step, explicit, dissipative approximations to scalar hyperbolic problems were studied in the quarter plane x greater than or = to 0, t greater than or = to 0. In both, outflow and inflow cases, Kriess' theory was used to derive significant stability criteria which are independent of the basic difference scheme, and are stated entirely in terms of the boundary conditions. These criteria take a very simple form when the boundary conditions are translatory. The results were applied to several well known boundary treatments, and overall stability was achieved without effort. Author

N78-21847# University of Southern Calif., Los Angeles. Modelling Research Group.

DIRECT TRANSFORMATION OF VARIATIONAL PROBLEMS INTO CAUCHY SYSTEMS. 1: SCALAR-QUADRATIC CASE Interim Report

James Hess and Robert Kalaba 1977 13 p refs

(Grant AF-AFOSR-3383-77)

(AD-A049526; USCMRG-7710; AFOSR-78-0016TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This series of papers addresses three interrelated problems: the solution of a variational minimization problem, the solution of integral equations, and the solution of an initial valued system of integrodifferential equations. It will be shown that a large class of minimization problems requires the solution of linear Fredholm integral equations. It has also been shown that the solution of a linear Fredholm integral equation is identical to the solution of a Cauchy system. In this paper, we by-pass the Fredholm integral equations and show that the minimization problem directly implies a solution of a Cauchy system. This first paper in the series looks only at quadratic functionals and scalar functions. Author (GRA)

N78-21848# University of Southern Calif., Los Angeles. Modelling Research Group.

DIRECT TRANSFORMATION OF VARIATIONAL PROBLEMS INTO CAUCHY SYSTEMS. 2: SCALAR-SEMI-QUADRATIC CASE Interim Report

James Hess, Harriet Kagiwada, and Robert Kalaba 1977 15 p refs

(Grant AF-AFOSR-3383-77)

(AD-A049527; USCMRG-7719; AFOSR-78-0030TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This series of papers addresses three interrelated problems: The solution of a variational problem, the solution of integral equations, and the solution of an initial valued system of integrodifferential equations. It will be shown that a large class of variational problems requires the solution of a non-linear integral equation. It has also been shown that the solution of a non-linear integral equation is identical to the solution of a Cauchy system. This paper by-passes the non-linear integral equations and shows that the minimization problems directly imply a solution of the Cauchy system. This second paper in the series looks at semi-quadratic functional and scalar functions. GRA

N78-21849# Syracuse Univ., N. Y. Dept. of Industrial Engineering and Operations Research.

MATRIX INVERSION USING THE RADC STARAN ASSOCIATIVE ARRAY PROCESSOR Phase Report, Sep. 1975 - Apr. 1977

P. Bruce Berra and Ellen Oliver Dec. 1977 136 p refs

(Contract F30602-75-C-0121)

(AD-A049617; RADC-TR-77-386) Avail: NTIS HC A07/MF A01 CSCL 09/2

The algorithm reported here is implemented on the RADC STARAN and then used to invert test matrices. Matrices of dimensions 30 x 30, 45 x 45, 60 x 60 and 80 x 80 are inverted and these results are timed. The same matrices were inverted using APL Plus. In the cases of the 30 x 30 and 45 x 45 matrices, a direct comparison was made; this comparison indicates a time savings of 11.82% and 15.49% respectively for the STARAN. For the two larger matrices, the APL plus times were extrapolated and the comparison of this extrapolated time with the STARAN time for the 60 x 60 matrix and 80 x 80 matrix indicates a time savings of 31.77% and 62.44% respectively, for the STARAN. In addition to reporting the test results, background material is presented to acquaint the reader with the RADCAP facility; this includes a discussion of STARAN architecture and the specific procedures required to submit a job to STARAN via the MULTICS system. The object code for inverting a 60 x 60 matrix is included and discussed in detail. Finally, recommendations for future research are discussed based upon the new STARAN Model E which has a larger array size capability. GRA

N78-21850# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.

DIRECT NUMERICAL SOLUTION OF LARGE SETS OF SIMULTANEOUS EQUATIONS

H. A. Kamel and M. W. McCabe 20 Jan. 1978 47 p refs (Contract N00014-75-C-0837)

(AD-A050058; TR-3) Avail: NTIS HC A03/MF A01 CSCL 12/1

The paper attempts to survey, classify and compare methods available for the solution of simultaneous equations on a digital computer. It is known that, for direct methods, the amount of central processor time required to perform the solution varies little from one method to the other. More interesting than the algorithm is the data handling method. The basis for comparison here is core utilization and the number of required I/O operations. Low core utilization means higher program capacity and increased generality, whereas a low I/O activity improves efficiency and reduces system residence time. One of the interesting findings in a comparative study of the demands on computer resources is that the data handling method is indeed the deciding factor, rather than the mathematical algorithm. GRA

N78-21851# Purdue Univ., Lafayette, Ind. Dept. of Mathematics.

A MINIMUM PRINCIPLE FOR THE SMALLEST EIGENVALUE FOR SECOND ORDER LINEAR ELLIPTIC EQUATIONS WITH NATURAL BOUNDARY CONDITIONS Interim Report

Charles J. Holland Aug. 1977 22 p refs

(Grant AF-AFOSR-3286-77)

(AD-A050101; AFOSR-78-0121TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper gives a new characterization of the smallest eigenvalue for second order linear elliptic partial differential equations, not necessarily self-adjoint, with both natural and Dirichlet boundary conditions, and also gives a new alternative numerical method for calculating both the smallest eigenvalue and corresponding eigenvector in the case of natural boundary conditions. The smallest eigenvalue, if appropriate sign changes are made, determines the stability of equilibrium solutions to certain second order nonlinear partial differential equations. The corresponding eigenvector enables one to determine the first approximation of the solution of the nonlinear equation to variations of the initial conditions from the equilibrium solution. These nonlinear equations are important in the applications. For these reasons it is important to have these characterizations of the smallest eigenvalue and eigenvector. Our method converts the determination of the eigenvalue and eigenvector to determining the solution of a stationary stochastic control problem. This latter problem is solved and from it a numerical scheme arises naturally. This method appears to have applications in solving other problems. GRA

N78-21852# Princeton Univ., N. J. Dept. of Statistics.

FURTHER PROGRESS ON ROBUST/RESISTANT WIDTHERS

John W. Tukey, Henry I. Braun, and Michael Schwarzschild Aug. 1977 18 p

(Grant DAAG29-76-G-0298)

(AD-A049701; TR-129-SER-2; ARO-14244.1-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

This report describes work on the development of robust estimators of width. An earlier technical report, an Interim Report of a Monte Carlo Study of Robust Estimators of Width describes previous work undertaken in connection with this project. Essentially a single family of estimators (together with a few obvious variations) was investigated for sample sizes n=10 and n=20, using Monte Carlo methods. The authors were motivated by considerations of conceptual and computational simplicity as well as a desire to achieve high robustness of efficiency. Moderate

success was achieved on both counts. In fact apparent triefficiencies of 89% were obtained for sample size 10. GRA

N78-21853# Rice Univ., Houston, Tex.
MATHEMATICS OF OPERATIONS RESEARCH Final Report, 1 Aug. 1974 - 15 Oct. 1977
Robert M. Thrall Jan. 1978 9 p refs
(Grants DAHC04-74-G-0223; DAHC04-76-G-0305; DAHC04-76-G-0012; NSF MCS-76-23865)
(AD-A049700; ARO-12414.2-M) Avail: NTIS HC A02/MF A01 CSCL 12/2

This report briefly summarizes research on the following topics: game theory and energy; scheduling of large research and development programs; bimatrix games; cost/benefit analyses; measures of worth of weapons systems; hybrid primal algorithm; branch and round algorithm. A listing of papers prepared and published is included. Author (GRA)

N78-21854# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
SOLUTIONS TO THE KALMAN FILTER WORDLENGTH PROBLEM: SQUARE ROOT AND U-D COVARIANCE FACTORIZATIONS
Peter S. Maybeck Sep. 1977 67 p refs
(AD-A049704; AFIT-TR-77-6) Avail: NTIS HC A04/MF A01 CSCL 09/3

This report presents the concept of square root filters and the closely related U-D covariance factorization filter as viable alternatives to conventional Kalman filters. For a modest increase in computational loading, one obtains optimal filter algorithms equivalent to the Kalman filter if infinite wordlength is assumed, but with vastly superior numerical characteristics with finite wordlength. These algorithms are at least as good as a solution to troublesome measurement update computations as implementing a Kalman filter in double precision, since the Kalman filter inherently involves unstable numerics. The filter algorithms are developed and presented in a form convenient for implementation. Of the covariance square root forms, the Carlson filter is more efficient than the Potter form computationally, and it also maintains triangularity of the square root matrices. The U-D covariance factorization filter is even more efficient, not requiring square root computations. In comparison, the inverse covariance square root filter is often considerably more burdensome, although it too becomes competitive if the measurement dimension is very large. Author (GRA)

N78-21855# Stanford Univ., Calif. Dept. of Statistics.
DISTRIBUTION OF A SUM OF WEIGHTED CHI-SQUARE VARIABLES
H. Solomon and M. A. Stephens 2 Jun. 1977 17 p refs
(Contract N00014-76-C-0475; Grant DAAG29-77-G-0031)
(AD-A049986; SU-TR-245; SU-TR-5; ARO-14435.7-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper discusses how to obtain percentage points of the distribution of a sum of k weighted chi-square variables. A table of points is given for selected weights, for k = 6, 8, 10 (existing tables are for k + or - 5). The new points have been calculated by a technique of Imhof which gives very accurate values but is expensive in computer time. Therefore two new approximations are considered: a Pearson curve fit using four moments and a chi-square fit using three. Both give excellent results in the upper tail, the tail usually needed for practical applications; the chi-square fit appears superior to other approximations in the lower tail. GRA

N78-21856# Stanford Univ., Calif. Dept. of Statistics.
APPROXIMATE SOLUTIONS FOR CERTAIN OPTIMAL STOPPING PROBLEMS
Albert John Petkau 5 Jan. 1978 23 p refs Prepared in cooperation with MIT, Cambridge
(Contract N00014-75-C-0555; Grant DAAG29-77-G-0031; NR Proj. 042-331)
(AD-A049995; SU-TR-9; TR-13; ARO-14435.13-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

Simple methods of determining numerical approximations to the optimal continuation regions of certain optimal stopping problems for a zero drift standard Wiener process are described. The methods involve the use of the solutions of analogous discrete problems together with a correction for continuity. A problem due to Van Moerbeke, the exact solution of which is known, and the one-armed bandit problem are considered as illustrations of the methods. GRA

N78-21857# Texas A&M Univ., College Station. Dept. of Mathematics.
SYSTEMS OF GENERALIZED ABEL INTEGRAL EQUATIONS Interim Report
M. Lowengrub and J. R. Walton 17 Oct. 1977 32 p refs Prepared in cooperation with Indiana Univ., Bloomington
(Grants AF-AFOSR-3290-77; NSF MCS-75-03894A2)
(AD-A050001; AFOSR-78-0045TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

A method is presented for solving systems of generalized Abel integral equations by reduction to equivalent coupled Riemann-Hilbert boundary value problems. It is demonstrated how the Riemann system may be uncoupled and closed form solutions computed. An application is then given to solving certain simultaneous dual relations which arise in bimedia fracture problems in elasticity. Author (GRA)

N78-21858# Texas Univ., Austin. Dept. of Mathematics.
A ROAD MAP OF METHODS FOR APPROXIMATING SOLUTIONS OF TWO-POINT BOUNDARY-VALUES PROBLEMS
James W. Daniel Jan. 1978 43 p refs Proposed for presentation at Working Conf. on Codes for Boundary-value Problems in ODES, Houston, Tex., May 1978
(Contract N00014-76-C-0275)
(AD-A049971; CNA-130) Avail: NTIS HC A03/MF A01 CSCL 12/1

Numerical methods for approximating solutions of two-point boundary-value problems for ordinary differential equations are surveyed. Specific complete algorithms are classified according to how the original problem is transformed, how the transformed problem is modeled discretely, and how the discrete model is solved. Relationships among various complete algorithms are presented. Convergence acceleration, error estimation and control, and parameter selection are also discussed. Author (GRA)

N78-21859# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
A LIAPUNOV FUNCTIONAL FOR A MATRIX NEUTRAL DIFFERENCE-DIFFERENTIAL EQUATION WITH ONE DISPLAY
W. B. Castelan and E. F. Infante Nov. 1977 45 p refs Sponsored in part by Coordenacao do Aperfeicoamento de Pessoal de Nivel Superior
(Contract N00014-76-C-0278; Grants DAAG29-76-G-0294; NSF MCS-76-07247)
(AD-A049868) Avail: NTIS HC A03/MF A01 CSCL 12/1

For the matrix neutral difference-differential equation x(dot)(t) - Ax(dot(t-tau) = Bx(t) - Cx(t-tau) a quadratic Liapunov functional is constructed which gives necessary and sufficient conditions for the asymptotic stability of the solutions of that equation. A difference equation approximation is considered of the difference-differential equation, and for this difference equation a Liapunov function is constructed from which is obtained the desired Liapunov functional by an appropriate limiting process. The Liapunov functional thus obtained gives the best possible estimate for the rates of growth or decay of the solutions of the matrix neutral difference-differential equation. The results obtained are natural generalizations of previous results obtained for a matrix retarded difference-differential equation with one delay. GRA

N78-21860# Wisconsin Univ., Madison. Mathematics Research Center.
ON A MEASURE OF LACK OF FIT IN TIME SERIES MODELS
G. M. Ljung and G. E. P. Box Sep. 1977 19 p refs
(Contract DAAG29-75-C-0024; Grant AF-AFOSR-2363D-72)
(AD-A049397; MRC-TSR-1790) Avail: NTIS HC A02/MF A01 CSCL 12/1

The overall test for lack of fit in autoregressive-moving average models is considered. It is shown that a substantially improved approximation results from a simple modification of this test.

Some consideration is given to the power of such tests and their robustness when the innovations are non-normal. Similar modifications in the overall tests used for transfer function-noise models are proposed. GRA

N78-21861# Wisconsin Univ., Madison. Mathematics Research Center.

APPLICATION AND NUMERICAL SOLUTION OF ABEL-TYPE INTEGRAL EQUATIONS

R. S. Anderssen (Australian Natl. Univ.) Sep. 1977 56 p refs
(Contract DAAG29-75-C-0024)
(AD-A049396; MRC-TSR-1787) Avail: NTIS HC A04/MF A01 CSCL 12/1

This paper reviews the numerous applications in which the solution of equations like the Abel-type integral equation for discrete observational data (d sub i) is the basic step, compares, with respect to given discrete observational data (d sub i), the use of pseudo-analytic methods and the direct evaluation of its inversion formulas as a basis for solving this equation, proposes a specific algorithm based on these conclusions, and examines the consequences of the fact that, for the equation, linear functionals defined on its solution u(x) can be redefined as linear functionals on the data s(y). The justification for the latter is that, in applications involving separable first kind Abel-type integral equations, inferences are usually based on (linear) functionals defined on u(x), not on u(x) itself. This point is illustrated with an example from metallurgy. GRA

N78-21862# Wisconsin Univ., Madison. Mathematics Research Center.

ASYMPTOTIC DISTRIBUTION OF SYMMETRIC STATISTICS

H. Rubin and R. A. Vitale Jul. 1977 11 p refs
(Contract DAAG29-75-C-0024; NSF MCS-76-08316)
(AD-A049395; MRC-TSR-1775) Avail: NTIS HC A02/MF A01 CSCL 12/1

Sequences of mth order symmetric statistics are examined for convergence in law. Under appropriate conditions, a limiting distribution exists and is equivalent to that of a linear combination of products of Hermite polynomials of independent N(0,1) random variables. GRA

N78-21863# Stanford Univ., Calif. Dept. of Statistics.

CONFIDENCE INTERVALS RELATED TO SEQUENTIAL TESTS FOR THE EXPONENTIAL DISTRIBUTION

D. Siegmund 10 Oct. 1977 25 p refs
(Contract N00014-77-C-0306; NR Proj. 042-373)
(AD-A049758; TR-3) Avail: NTIS HC A02/MF A01 CSCL 12/1

One sided sequential tests for the mean of an exponential distribution are proposed, and the related confidence intervals are computed. The tests behave like the classical sequential probability ratio test when the mean is small and like a fixed time test when the mean is large and accurate estimation is important. Author (GRA)

N78-21864# Stanford Univ., Calif.

A NON-LINEAR RENEWAL THEORY WITH APPLICATIONS TO SEQUENTIAL ANALYSIS, 2

T. L. Lai and D. Siegmund 3 May 1977 33 p refs
(Contracts N00014-77-C-0306; N00014-75-C-0560; Grant NSF MCS-76-09179; NR Proj. 042-373)
(AD-A049783; SUTR-1) Avail: NTIS HC A03/MF A01 CSCL 12/1

An analogue of Blackwell's renewal theorem is obtained for processes Z sub n = S sub n + xi sub n, where S sub n is the nth partial sum of a sequence x1,x2,... of independent identically distributed random variables with finite positive mean and xi sub n is independent of x sub n+1, x sub n+2,... and has sample paths which are slowly changing in a sense made precise below. As a consequence, asymptotic expansions up to terms tending to 0 are obtained for the expected value of certain first passage times. Applications to sequential analysis are given. GRA

N78-21865# Yale Univ., New Haven, Conn.

THE STABILITY OF SECOND ORDER QUADRATIC DIFFERENTIAL EQUATIONS

Daniel E. Koditschek and Kumpati S. Narendra Nov. 1977 30 p refs
(Contract N00014-67-C-0097-0020)
(AD-A049771; SIS-7709) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper a detailed study of the stability properties of the quadratic differential equation is undertaken. After observing that such systems can never be asymptotically stable the equilibrium states of the quadratic differential equation are classified in terms of the matrices G and H. Necessary and sufficient conditions for the stability of the origin are derived and constitute the principal contribution of this paper. Finally, these conditions are re-derived and elaborated using polar coordinates which allow a convenient classification of instability behavior. This exhausts the stability characteristics (in the sense of Lyapunov) of second order quadratic differential equations. GRA

N78-21866# Stanford Univ., Calif. Dept. of Computer Science.

THE CONVERGENCE OF FUNCTIONS TO FIXED POINTS OF RECURSIVE DEFINITIONS

Zohar Manna and Adi Shamir (MIT, Cambridge) May 1977 49 p refs Prepared in cooperation with Weizmann Inst. of Sci., Rehovoth, (Israel)
(Contract MDA903-76-C-0206; ARPA Order 2494)
(AD-A049760; SUSTAN-CS-77-614; SU-AIM-299) Avail: NTIS HC A03/MF A01 CSCL 12/1

The classical method for constructing the least fixedpoint of a recursive definition is to generate a sequence of functions whose initial element is the totally undefined function and which converges to the desired least fixedpoint. This method, due to Kleen, cannot be generalized to allow the construction of other fixedpoints. This paper presents an alternate definition of convergence and a new fixedpoint access method of generating sequences of functions for a given recursive definition. The initial function of the sequence can be an arbitrary function, and the sequence will always converge to a fixedpoint that is 'close' to the initial function. This defines a monotonic mapping from the set of partial functions onto the set of all fixedpoints of the given recursive definition. GRA

N78-21867# California Univ., Livermore. Lawrence Livermore Lab.

ROLE OF STATISTICAL LINEARIZATION IN THE SOLUTION OF NONLINEAR STOCHASTIC EQUATIONS

A. B. Budgor 31 Aug. 1977 37 p refs Presented at Intern. Conf. on Stochastic Behavior and Quantum Hamiltonian Systems, Tremezzo, Italy, 20 Jun. 1977
(Contract W-7405-eng-48)
(UCRL-80094; Conf-770692-2) Avail: NTIS HC A03/MF A01

The solution of a generalized Langevin equation is referred to as a stochastic process. If the external forcing function is Gaussian white noise, the forward Kolmogarov equation yields the transition probability density functions. Perturbation theories, eigenfunction, expansions, and nonlinear optimization procedures are discussed. Nonlinear stochastic systems exhibiting sustained or forced oscillations and the centered nonlinear Schroedinger equation in the presence of Gaussian white noise excitation are considered as examples. ERA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N78-21868 City Univ. of New York.

STATIONARY STOCHASTIC AND DISCRETE MARKOV PROCESS. PART 1: THE RANGE OF A STRICTLY STATIONARY STOCHASTIC PROCESS. PART 2: SOME ADDITIONAL RESULTS CONCERNING LIMITS OF A DISCRETE MARKOV PROCESS Ph.D. Thesis

Leo Chosid 1977 85 p
Avail: Univ. Microfilms Order No. 77-28652

The range of a random walk was extended to more general

stochastic processes. Necessary and sufficient conditions for the limit of n yields infinity of 1/n k = 1 the sum of n P(k)(x,A) to exist for a fixed point x and any measurable set A where P(x,.) is an m-invariant transition probability is given. In addition the existence of the above limit can be assured for all x and every measurable set A under a weaker condition, then condition is not contained in the set of Harris. The weak Banach limit to generate invariant measures was also introduced. Dissert. Abstr.

N78-21869 Wyoming Univ., Laramie.
THE COMPREHENSION FACTOR IN RANDOMIZED RESPONSE Ph.D. Thesis
Dennis Melvin Obrien 1977 120 p
Avail: Univ. Microfilms Order No. 7800174

The concept of comprehension, which includes willingness and ability to follow instructions, is introduced into the Warner and Simmons randomized response models. Appropriate mean-square-error formulas are derived for each and comparisons are then made on the basis of the MSE's to identify situations where the usually less precise Warner procedure becomes more precise than the Simmons procedure. Such a situation is now possible as a result of the estimators being biased under less than total comprehension. Both the level of comprehension and the action taken by the non-comprehenders are considered while the comparisons are made. Consideration is also given to the concepts of a known comprehension level and a known noncomprehender response parameter.
Dissert. Abstr.

N78-21870 Virginia Polytechnic Inst. and State Univ., Blacksburg.
NONPARAMETRIC PROCEDURES FOR PROCESS CONTROL Ph.D. Thesis
Saad Taha Bakir 1977 135 p
Avail: Univ. Microfilms Order No. 7801576

Three nonparametric control chart procedures are developed. The procedures are designed to detect any shift in the median of a sequence of observations from specified control value. The first two procedures require that groups of g greater than or equal to 1 observations be made sequentially on the output of the process. Then the Wilcoxon signed-ranks of the observations are computed within each group separately. One of the two procedures employs a cumulative sum control chart type stopping rule and its signals indicating a shift in the median of the process. The third procedure is proposed for situations where single observations, rather than grouped observations, are made on the output of the process. Several comparisons of the proposed procedures were made with other parametric control chart procedures.
Dissert. Abstr.

N78-21871 Oklahoma State Univ., Stillwater.
RANDOMIZED RESPONSE DESIGNS Ph.D. Thesis
Sorachai Bhisalbutra 1976 122 p
Avail: Univ. Microfilms Order No. 7801207

Randomized response models that increase the cooperation of the respondent, simplify the estimation of the parameters; and at the same time decrease the variances of the randomized response estimators are developed. Two randomized response models for proportions (Model I and Model II) and five randomized response models for quantitative data (Model III to Model VII) have been proposed in this paper. The description of the models and estimation of the parameters, including the models based on repeated trials per respondent, have been discussed. A brief discussion comparing estimates obtained both by direct and randomized response models for proportions under different assumptions is made to see where a new model has potential advantages over the direct interviewing process and other available models.
Dissert. Abstr.

N78-21872 South Carolina Univ., Columbia.
CONVERGENCE OF WEIGHTED SUMS OF RANDOM ELEMENTS AND STATISTICAL APPLICATIONS Ph.D. Thesis
Duan Wei 1977 60 p
Avail: Univ. Microfilms Order No. 78-01187

Some basic properties of tightness are obtained, and counterexamples are developed for some plausible conjectures. An important property shows that the centered sequence of a sequence of tight random elements with rth moment condition remains tight. Thus, it can be assumed without loss of generality that the random elements have zero means. Convergence in probability for Toeplitz weighted sums of tight random elements with an rth moment condition (r > l) is shown to be equivalent for the weak linear and norm topologies of a separable Banach space. The essential part of the proof is the technique of truncation to a compact subset which can be proved to be almost finite dimensional. A counterexample shows that the rth moment condition cannot be reduced for these results. These results are applied to obtain convergence results of stochastic processes. Without assuming tightness, geometric conditions are imposed to obtain a weak convergence of weighted sums. The weights are allowed to be random variables, and the results are shown to be applicable to control charts and regression analysis.
Dissert. Abstr.

N78-21873# Tennessee Univ., Knoxville. Dept. of Psychology.
ESTIMATION OF THE OPERATING CHARACTERISTICS OF ITEM RESPONSE CATEGORIES. 1: INTRODUCTION TO THE TWO-PARAMETER BETA METHOD
Fumiko Samejima Dec. 1977 113 p refs
(Contract N00014-77-C-0360; RR0420401)
(AD-A049618; RR-77-1) Avail: NTIS HC A06/MF A01 CSCL 12/1

Following the Normal Approximation Method, in this study, the Two-Parameter Beta Method is developed and introduced, as a method of estimating the operating characteristics of a test without assuming any prior model. The maximum likelihood estimation, Theta-bar, and its asymptotic property such that its conditional distribution, given ability Theta, is N(Theta, 1/I(theta), where I(Theta) is the test information function, are fully utilized. An approximation is made for the conditional distribution of Theta, given Theta-bar, by a Beta distribution using the method of moments, with two a priori set parameters and the other two estimated parameters from the first two conditional moments of Theta, given Theta-bar. The least square principle is adopted in estimating two parameters in the normal ogive model for each item.
GRA

N78-21874# Georgia Univ., Athens. Dept. of Statistics and Computer Science.
INTERACTIVE STATISTICAL SOFTWARE Final Report
Rolf E. Bargmann, ed. and Hubert Bouver, ed. Jan. 1978 166 p refs
(Contract N00014-69-A-0423)
(AD-A049707; THEMIS-UGA-33) Avail: NTIS HC A08/MF A01 CSCL 12/1

This narrative report consists of five chapters: Chapters 1 and 2 describe interactive graphical units and present examples of the use of these units, with photographs of the screen taken in the Fall of 1977, when the integrated system was operational on the latest monitor. Chapter 3 consists of a short description of the graphics system, including examples and considerations of transportation and adaptation to other systems. Chapter 4 describes those tasks which supported the software development, especially numerical analysis work and the development and testing of efficient and precise modules. Other statistical tasks performed under this grant are described in Chapter 5. Technical details, instructions to users and programmers, important formulas, and tables and selected displays of program uses are contained in six appendix volumes to this Final Report, which were distributed in the Fall of 1974.
GRA

N78-21875# Stanford Univ., Calif. Dept. of Statistics.
A STUDY OF RENEWAL PROCESSES WITH IMRL AND DFR INTERARRIVAL TIMES
Mark Brown 7 Jun. 1977 28 p refs
(Contract N00014-76-C-0475; Grant DAAG29-77-G-0031)
(AD-A049989; SU-TR-6; SU-TR-246; ARO-14435.8-M) Avail: NTIS HC A03/MF A01 CSCL 12/1

Consider renewal processes with IMRL (increasing mean residual life) and DFR (decreasing failure rate) interarrival times. Monotonicity properties for these processes are developed as well as two sided bounds for the renewal function.
GRA

N78-21876# Rochester Univ., N. Y. Dept. of Statistics.
ON THE CONVOLUTION OF LOGISTIC RANDOM VARI-

ABLES Interim Report
E. Olusegun George and Govind S. Mudholkar 1977 13 p refs
(Grant AF-AFOSR-3360-77; AF Proj. 2304)
(AD-A049996; AFOSR-78-0041TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The logistic distribution is used for stochastic modelling in fields of applications such as biology, economics, and medicine. The convolution of logistic random variables plays an important role in the estimation of and testing of hypotheses regarding the parameters of the distribution. In this paper the characteristic function is inverted to obtain a neat expression for the d.f. of the convolution. It is demonstrated that a student's t-distribution provides a very close approximation to the convolution.
Author (GRA)

N78-21877# Minnesota Univ., Minneapolis. Dept. of Theoretical Statistics.
SIMULATION STUDIES ON SOME NEAREST NEIGHBOR RULES FOR STATISTICAL CLASSIFICATION
Somesh DasGupta and David Aarons Nov. 1977 15 p refs
(Grant DAAG29-76-G-0038)
(AD-A049548; UMN/DTS/TR-303; ARO-13149.4-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

The performances of the distance nearest neighbor rule, one-stage rank nearest neighbor rule and two-stage rank nearest neighbor rule for the two-population statistical classification problem are studied through simulation processes. Normal distributions with different mean, normal distributions with different variances, exponential distributions and Cauchy distributions are considered. Author (GRA)

N78-21878# Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics.
APPROXIMATE SOLUTIONS FOR CERTAIN OPTIMAL STOPPING PROBLEMS
A. John Petkau (British Columbia Univ., Vancouver) 21 Dec. 1977 26 p refs
(Contract N00014-75-C-0555; Grant DAAG29-77-G-0031)
(AD-A049556; TR-8) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper presents simple approximate methods which lead to arbitrarily accurate numerical approximations to the optimal continuation regions of optimal stopping problems involving a zero drift standard Wiener process. The methods involve approximating the Wiener process by a simple random walk, solving the analogous problem for the random walk, and subsequently applying a correction for continuity due to Chernoff and Petkau to the solution of the discrete problem. The methods are illustrated in a problem due to Van Moerbeke for which the exact solution is known and in the one-armed bandit problem which has arisen in several different contexts in the statistical literature. Author (GRA)

N78-21879# Stanford Univ., Calif. Dept. of Operations Research.
SOME NUMERICAL RESULTS ON ASYMPTOTIC FAILURE DISTRIBUTIONS
Gary Gottlieb 14 Oct. 1977 18 p refs
(Contract N00014-75-C-0561; NR Proj. 042-002)
(AD-A049775; SU-TR-186) Avail: NTIS HC A02/MF A01 CSCL 14/4

Consider a single device shock model. The device is subject to shocks from the environment and eventually a shock will cause the device to fail. In an earlier paper, an asymptotic approximation for the time-to-failure distribution of the device was given. This paper computes numerically the actual time-to-failure distribution for various cases and then compares these distributions with the asymptotic approximations. GRA

N78-21880# Stanford Univ., Calif. Dept. of Statistics.
ESTIMATION FOLLOWING SEQUENTIAL TESTS
D. Siegmund 1 Oct. 1977 27 p refs
(Contract N00014-77-C-0306; Grant PHS GM-16895-08; NR Proj. 042-373)
(AD-A049784; TR-2) Avail: NTIS HC A03/MF A01 CSCL 12/1

Two methods for obtaining sequential test based confidence intervals for the mean of a normal distribution are proposed and compared. One method involves reducing the bias introduced into the sample mean by optional stopping. The other defines the confidence interval directly in terms of the stopping time of the test. Author (GRA)

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N78-21881 California Inst. of Tech., Pasadena.
THE PROBLEM OF EXIT AGAINST A FLOW FOR DYNAMICAL SYSTEMS Ph.D. Thesis
Randall Gary Williams 1978 124 p
Avail: Univ. Microfilms Order No. 7732575

The problem of exit against a flow for dynamical systems subject to small Gaussian white noise excitation was studied. Here the word flow refers to the behavior in phase space of the unperturbed system's state variables. Singular perturbation techniques are used to express the asymptotic solution in terms of an unknown parameter. The unknown parameter is determined using the solution of the adjoint boundary value problem. The problem of exit against a flow for several dynamical systems of physical interest is considered, and the mean exit times and distributions of exit positions are calculated. The systems are then simulated numerically, using Monte Carlo techniques, in order to determine the validity of the asymptotic solutions.
Dissert. Abstr.

N78-21882# Brown Univ., Providence, R. I. Div. of Engineering.
GLOBAL CONTROLLABILITY FOR A CLASS OF BILINEAR SYSTEMS Interim Report
K. C. Wei and A. E. Pearson Nov. 1977 10 p refs
(Grant AF-AFOSR-2793-75)
(AD-A049518; AFOSR-78-0019TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Sufficient conditions for global controllability of a class of bilinear and nonlinear systems have been derived. These results shed some light in applying fixed-point arguments to investigate the controllability of nonlinear systems which contain unbounded nonlinearities. An interesting problem is to link the closeness of the attainable set for commutative bilinear systems with the conditions obtained here so that an explicit input function can be derived or computed through iterative schemes.Author (GRA)

N78-21883# Brown Univ., Providence, R. I. Div. of Engineering.
A MODIFIED QUADRATIC COST PROBLEM AND FEEDBACK STABILIZATION OF LINEAR DISCRETE TIME SYSTEMS Interim Report
W. H. Kwon and A. E. Pearson Sep. 1977 33 p refs
(Grant AF-AFOSR-2793-75)
(AD-A049519; AFOSR-78-0018TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

This report considers a feedback control law for linear time-varying and time invariant discrete systems based on a receding horizon concept applied to a minimum energy problem with fixed terminal constraints. The control law is shown to be asymptotically stable and to result in a new method for stabilizing linear time-varying systems as well as extending some well known methods for stabilizing time invariant systems. In particular, the stabilizing gains of the feedback control law are obtained from the solution to a discrete Riccati equation over an arbitrary finite time interval, which is relatively easy to compute. The gain matrix reduces to a constant matrix for linear time invariant systems. Some stability results will turn out to be special cases of these results. The results parallel those for linear continuous time systems, although the technical details are tedious and more involved. GRA

N78-21884# Brown Univ., Providence, R. I.
ON FEEDBACK STABILIZATION OF TIME VARYING DISCRETE LINEAR SYSTEMS Interim Report
W. H. Kwon and A. E. Pearson Nov. 1977 10 p refs

(Grant AF-AFOSR-2793-75)
(AD-A049530; AFOSR-78-0020TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Results are given for stabilizing time varying discrete linear systems by means of a feedback control stemming from a receding horizon concept and a minimum quadratic cost with a fixed terminal constraint. The results parallel those recently obtained from continuous time systems (8) and extend a well known method of Kleinman for stabilizing discrete fixed linear systems. Author (GRA)

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N78-21885 Yeshiva Univ., New York.
DECOMPOSITION THEOREMS FOR DIFFERENTIAL FORMS ON HILBERT SPACES Ph.D. Thesis
Thomas Goldring 1977 105 p
Avail: Univ. Microfilms Order No. 7732530

The theories of Hodge and Frobenius are extended to differential forms on Hilbert spaces. An operator is constructed for infinite dimensional forms and the infinite dimensional potential theory is discussed. A method given for classifying isolated zeros is relevant to the extension of results of B. Malgrange (who works in the finite dimensional holomorphic case) to the real nonanalytic case. Dissert. Abstr.

N78-21886 Columbia Univ., New York.
A CHARACTER FORMULA FOR THE DISCRETE SERIES OF A SEMISIMPLE LIE GROUP Ph.D. Thesis
Jorge Antonio Vargas 1977 116 p
Avail: Univ. Microfilms Order No. 78-02316

Let G be a connected, semisimple matrix group. An irreducible unitary representation Pi of G is said to be square integrable if it can be realized on an invariant, irreducible subspace of the left (or right) regular representation. The discrete series is the set of isomorphism classes of such square integrable, irreducible unitary representations. In the representation theory of semisimple Lie groups, as developed by Harish-Chandra, the discrete series representations play the most fundamental role; roughly speaking, every unitary representation which enters the Plancherel decomposition of L squared(G) is either a discrete series representation, or is obtained from a discrete series representation of a lower dimensional subgroup by an inducing process. The main result is a completely explicit formula for theta sub lambda, restricted to the identity component of A, in this situation. Dissert. Abstr.

N78-21887 Kent State Univ., Ohio.
AVERAGING IN BANACH SPACES Ph.D. Thesis
Charles John Seifert 1977 48 p
Avail: Univ. Microfilms Order No. 7800359

A Banach space X is said to have the Banach-Saks property if every bounded sequence, (x sub n) in X, has a subsequence, (x sub n sub k) of (x sub n). W. Szlenk showed that L sub 1 has the weak Banach-Saks property. Using some of Szlenk's techniques, it is shown that, in the case where X is reflexive, (L sub 1)(X) has the weak Banach-Saks property if and only if (L sub 2)(X) has the Banach-Saks property. Therefore, (L sub 1)(X) has the weak Banach-Saks property whenever X is a uniformly convex space or a reflexive, B-convex space. A modification of the proof of the above theorem makes it possible to show that (L sub 1)(X) has the weak Banach-Saks property if and only if (L sub 2)(X) has the weak Banach-Saks property. This slight improvement shows that (L sub 1)(X) has the weak Banach-Saks property whenever X is B-convex. Dissert. Abstr.

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

No abstracts in this category.

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N78-21888 Rochester Univ., N. Y.
A STUDY OF THE INTERACTION OF X-RAYS AND ACOUSTIC WAVES IN SOLIDS Ph.D. Thesis
Allan Hauer 1977 273 p
Avail: Univ. Microfilms Order No. 7725458

Analysis of the basic properties of X-ray propagation in solids revealed that practical methods for X-ray control or modulation must involve changes in the spatial configuration of X-ray scatterers. Numerical methods for the study of X-ray propagation in acoustically perturbed crystals are formulated. Emphasis was placed on Borrmann transmission in thick crystals. Modulation and shuttering (on a micro-second timescale) of X-rays are experimentally demonstrated. A quantitative investigation of the basic interactions used to produce modulation and shuttering is presented. Agreement between the experimental observations and the theoretical predictions is within experimental error. An analytical investigation of the basic potential and limitations of X-ray modulation shuttering and control devices is presented. Basic design criteria for X-ray modulation devices is formulated and applied to practical configurations. Dissert. Abstr.

N78-21889*# Kansas Univ. Center for Research, Inc., Lawrence.
EXPERIMENTAL AND THEORETICAL SOUND TRANSMISSION Progress Report
Jan Roskam, Vincent U. Muirhead, Howard W. Smith, and Donald W. Durenberger Jan. 1978 160 p refs
(Grant NsG-1301)
(NASA-CR-156170; KU-FRL-317-6) Avail: NTIS HC A08/MF A01 CSCL 20A

The capabilities of the Kansas University- Flight Research Center for investigating panel sound transmission as a step toward the reduction of interior noise in general aviation aircraft were discussed. Data obtained on panels with holes, on honeycomb panels, and on various panel treatments at normal incidence were documented. The design of equipment for panel transmission loss tests at nonnormal (slanted) sound incidence was described. A comprehensive theory-based prediction method was developed and shows good agreement with experimental observations of the stiffness controlled, the region, the resonance controlled region, and the mass-law region of panel vibration. A.R.H.

N78-21890*# MAN-Acoustics and Noise, Inc., Seattle, Wash.
RESPONSE TO ACTUAL AND SIMULATED RECORDINGS OF CONVENTIONAL TAKEOFF AND LANDING JET AIRCRAFT Final Report
J. E. Mabry and B. M. Sullivan Jan. 1978 78 p refs
(Contract NAS1-14404)
(NASA-CR-145318; MAN-1023-B) Avail: NTIS HC A05/MF A01 CSCL 20A

Comparability between noise characteristics of synthesized recordings of aircraft in flight and actual recordings were investigated. Although the synthesized recordings were more smoothly time-varying than the actual recordings and the synthesizer could not produce a comb-filter effect that was present in the actual recordings, results supported the conclusion that annoyance response is comparable to the synthesized and actual recordings. A correction for duration markedly improved the validity of engineering calculation procedures designed to measure noise annoyance. Results led to the conclusion that

the magnitude estimation psychophysical method was a highly reliable approach for evaluating engineering calculation procedures designed to measure noise annoyance. For repeated presentations of pairs of actual recordings, differences between judgment results for identical signals ranged from 0.0 to 0.5 db. Author

N78-21891# Committee on Public Works and Transportation (U. S. House).
AIRPORT AND AIRCRAFT NOISE REDUCTION
Washington GPO 1977 590 p refs Hearings on H.R. 4539 and related bills before Subcomm. on Aviation of the Comm. on Public Works and Transportation, 95th Congr., 1st Sess., 30-31 Mar., 5-6, 19-21, 27 Apr.; 5 May 1977
(GPO-91-591) Avail: Subcomm. on Aviation

The establishment of a comprehensive program for the systematic reduction of noncompatible land uses in areas surrounding certain airports in the United States and the level of noise created by aircraft operating at such airports was discussed in testimony delivered and statements submitted for the record during House hearings on the resolution. The text of the bill is included. A.R.H.

N78-21892# Naval Postgraduate School, Monterey, Calif.
SOUND TRANSMISSION FROM A TAPERED FLUID LAYER INTO A FAST BOTTOM M.S. Thesis
Gregory Bertman Netzorg Dec. 1977 49 p refs
(AD-A050021) Avail: NTIS HC A03/MF A01 CSCL 20/1

Acoustic energy transfer from a tapered fluid layer into a fast bottom was investigated experimentally using fresh water and a saline solution separated by a sheet of 0.5 mil mylar. A 150 kHz pulsed signal was excited in the upper layer and a receiver in the lower fluid layer was used to determine the acoustic field. Measurements were made for taper angles of 1.52, 2.51, and 4.41 deg and for (rho)c ratios of 0.745 and 0.836. Beams were observed in the lower layer, beginning at points where the depth of the tapered layer equals a cutoff depth for a normal mode. The experimental beam patterns agree well with the theoretical predictions for angles from grazing to the angle where the maximum pressure amplitude is reached. For greater angles, experiment and theory significantly diverge. Author (GRA)

N78-21893# Avco Systems Div., Wilmington, Mass.
INSTALLATION AND TEST OF DOPPLER ACOUSTIC SENSOR Final Report, Nov. 1974 - Sep. 1975
R. P. McConville Oct. 1977 100 p refs
(Contract DOT-TSC-939)
(AD-A049562; FAA-RD-76-223; FAA-77-25) Avail: NTIS HC A05/MF A01 CSCL 17/1

This report presents details of the installation of a Doppler acoustic vortex sensing system at JFK Runway 31R, the hardware and software improvements made since installation, vortex diagnostic and tracking data and analysis, and conclusions and recommendations. Author (GRA)

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N78-21894 Cornell Univ., Ithaca, N. Y.
KINETICS OF MODEL CHEMICAL REACTIONS Ph.D. Thesis
Dina Gutkowicz-Krusin 1977 170 p
Avail: Univ. Microfilms Order No. 7800070

The relationship between the microscopic processes occurring in a reacting mixture and the macroscopic changes in concentrations measured in kinetic experiments is investigated using the master equation approach. The effects on the rate constants of deviation from equilibrium and of the nonlinearity of the master equation are studied. The limits of validity of the phenomenological rate equation, and the phenomenological rate constants, are found for the exchange reaction within the framework of simple stochastic models. The rate constants are shown to depend on the total densities of the chemical species present in the mixture. The relationship between the time-dependent flux coefficients, that arise from the nonlinear master equation, and the true rate constants, is analyzed. Dissert. Abstr.

N78-21895 Ohio Univ., Athens.
THE EVALUATION AND ENERGY PROPAGATION OF RELATIVISTIC ELECTRON-NUCLEUS BREMSSTRAHLUNG AND VIRTUAL PHOTON SPECTRA Ph.D. Thesis
Claudio Wesley SotoVargas 1977 140 p
Avail: Univ. Microfilms Order No. 7732237

The virtual photon spectra results are presented for various multipoles, nuclear charges, and incident electron energies. As expected, the distortion effects of the nuclear charge are strong and monotonically increase as the nuclear charge increases. It is found that, contrary to previous results, the distorted wave calculation does not approach the plane wave results close to the elastic limit. This is important in that the giant dipole resonance already has considerable strength in this region for incident electrons with energies above 40 to 50 MeV. The radiation tail (bremsstrahlung cross section differential in the electron scattering angle) is presented for various electron incident energies, nuclear charges, and scattering angles. Bremsstrahlung involves the sum of many contributing multipoles and the calculation of the basic integrals loses precision after the first 8 or 10 multipoles. To handle this problem, the idea of a distortion factor is developed which enables the calculation of the radiation tail. Dissert. Abstr.

N78-21896 Pennsylvania Univ., Philadelphia.
THE UNITARITY CONSTRAINT ON THE THREE-BODY FINAL STATES Ph.D. Thesis
Tohru Takahashi 1977 137 p
Avail: Univ. Microfilms Order No. 7730260

The minimal set of linear scattering equations, which are compatible with unitarity and analyticity are discussed. Numerical solution of these minimal three-body equations is compared with the separable potential model solution in a simple three-boson model with nonresonant pair interaction. It is found that for short-range forces the minimal equations give the correct shape, but not magnitude, for the quasi-two-body amplitudes. The minimal three-body equations are applied to a simple three-boson model with resonant pair interaction. It is shown that the quasi-two-body amplitude has important variations over the three-body phase space even for relatively weak coupling and an approximate analytic expression is given for that amplitude that reproduces the variation for a wide range of parameters. Dissert. Abstr.

N78-21897 Pittsburgh Univ., Pa.
VACUUM ULTRAVIOLET AND VISIBLE RADIATION FROM ELECTRON IMPACT EXCITATION OF NITROGEN, HYDROGEN, OXYGEN, THE LIGHT HYDROCARBONS AND THE RARE GASES Ph.D. Thesis
Robert Ward McLaughlin 1977 181 p
Avail: Univ. Microfilms Order No. 7801817

Absolute emission cross sections were experimentally determined for vacuum ultraviolet and visible radiation resulting from the dissociative excitation of N2, H2, O2, CH4, C2H4 and C2H6, from the atomic excitation of Ar, Kr and Xe, and from the molecular excitation of N2. The technique involves the excitation of a diffuse gas source with a collimated electron beam. The resulting radiation was detected either by a vacuum ultraviolet or a visible monochromator; both monochromators view the interaction region simultaneously. The applications of these cross sections are discussed as they apply to the study of the upper atmosphere and for the calibration of optical detection instrumentation. The cross section measurements for radiation resulting from the molecular excitation of N2 are of special interest when analyzed in conjunction with inelastic scattering electron energy loss data. Dissert. Abstr.

N78-21898 Illinois Univ. at Chicago Circle, Chicago.
EXPERIMENTAL AND THEORETICAL STUDIES OF ION-MOLECULE SCATTERING Ph.D. Thesis
Frank Edward Budenholzer 1977 259 p
Avail: Univ. Microfilms Order No. 7732751

Incomplete total cross sections were measured for K(+) scattered by He, Ne, Ar, Kr, Xe, N2, CO, CO2, CH4, C2H4, C2H6, CF4 and SF6.. Measurements were carried out in the

range E theta sub R = 2 - 200 eV deg, where E is the energy of the K(+) beam and theta R is the resolution angle of the apparatus. Methods are developed for the spherically symmetric systems to calculate the classical incomplete total cross section as a function of the reduced resolution angle, Tau sub R = E theta sub R. Computed cross sections are compared to the experimental results for the rare gases and best fit potentials are determined in the region of the attractive well. Total cross sections were calculated for a model potential that included dipole and quadrupole contributions. The effects of these anisotropies on the total cross section are discussed. A Monte Carlo method for calculating classical differential cross sections for known potentials is developed. Dissert. Abstr.

N78-21899 Harvard Univ., Cambridge, Mass.
BROADNESS OF OPTICAL IMPURITY SPECTRA IN THE SOLID STATE Ph.D. Thesis
Roy Allen Auerbach 1977 247 p
Avail: Univ. Microfilms Order No. 7803428

The spectroscopic investigation of molecules is best carried out in those situations where a minimum interaction occurs between like molecules and with the environment. Conditions of minimal interaction occur for the solid state in dilute frozen solutions at low temperatures. Even so such impurity spectra only rarely produce high information content which occurs as a multitude of sharp lines, each corresponding to a change in the electronic and vibrational quanta for the molecule. A technique of selective excitation is presented which produces spectra with sharp lines from systems that produce broad spectra under normal spectroscopic methods. This technique, developed with the advent of tunable dye lasers, is then used to probe the various mechanisms causing broadness. A statistical model is presented to describe the inhomogeneous component of this broadening in a two level system. Dissert. Abstr.

N78-21900*# National Aeronautics and Space Administration, Washington, D. C.
STUDY OF DIATOMIC MOLECULES. 2: INTENSITIES
Jean-Louis Femenias Apr. 1978 27 p refs Transl. into ENGLISH from Can. J. Phys. (Can.), v. 55, 1977 p 1775-1786 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original doc. prep. by Nice Univ.
(Contract NASw-2790)
(NASA-TM-75290) Avail: NTIS HC A03/MF A01 CSCL 20H

The theory of perturbations, giving the diatomic effective Hamiltonian, is used for calculating actual molecular wave functions and intensity factors involved in transitions between states arising from Hund's coupling cases a,b, intermediate a-b, and c tendency. The Herman and Wallis corrections are derived, without any knowledge of the analytical expressions of the wave functions, and generalized to transitions between electronic states with whatever symmetry and multiplicity. A general method for studying perturbed intensities is presented using primarily modern spectroscopic numerical approaches. The method is used in the study of the ScO optical emission spectrum. Author

N78-21901# SRI International Corp., Menlo Park, Calif. Molecular Physics Center.
INELASTIC COLLISIONS OF EXCITED ATOMS Annual Report, Oct. 1976 - Dec. 1977
Keith T. Gillen 31 Jan. 1978 58 p refs
(Contract N00014-76-C-0118; SRI Proj. PYU-4529)
(AD-A050037; SRI-MP-78-13) Avail: NTIS HC A04/MF A01 CSCL 20/8

The interaction of metastable rare gas atoms with ground state atoms is being investigated in the energy range from several eV to several keV. Emphasis is on collisional ionization and collisional excitation transfer. Additional work examines the details of the charge transfer reaction used to produce the fast metastable beams. Author (GRA)

N78-21902# Tennessee Univ., Knoxville. Dept. of Physics and Astronomy.
STRUCTURE OF MULTIPLY IONIZED HEAVY IONS AND ASSOCIATED COLLISION PHENOMENA Annual Report
Ivan A. Sellin Jan. 1978 115 p refs
(Contract N00014-75-C-0474)
(AD-A049762; UTPA-7703) Avail: NTIS HC A06/MF A01 CSCL 20/8

Experiments concerning multiply ionized ions in the range Z = 3 - 36 and as broad as possible an energy range are presently being carried out. The primary objective is the study of atomic structure of multiply ionized heavy ions and their modes of formation and destruction in collisions. Decay of excited states of these ions by radiative and also by electron emission processes was observed. The principle tools were suitable sources and accelerators of multiply charged ions, X-ray, soft X-ray, and extreme ultraviolet spectrometers, electron spectrometers, lasers, on-line computer gear, and a variety of peripheral equipment associated with these devices. Author

N78-21903# California Univ., Berkeley. Lawrence Berkeley Lab.
SEMICLASSICAL METHODS FOR NONSEPARABLE SYSTEMS Ph.D. Thesis
B. C. Garrett Aug. 1977 194 p refs
(Contract W-7405-eng-48)
(LBL-6662) Avail: NTIS HC A09/MF A01

Work was done toward developing semiclassical theories for rate constants in reactive systems and semiclassical eigenvalues in bound systems. Semiclassical approximations were made to the quantum rate expression. Work was done toward a semiclassical quantum condition which is closest to the approach of Born. The Hamilton-Jacobi equation for the system is solved in action angle variables; in this way the classical Hamiltonian can be expressed as a function of action variables which are constants of motion for the system. Requiring the action variables to be integers provides the semiclassical eigenvalues. Numerical calculation was performed on a two dimensional coupled potential well with good agreement with the quantum eigenvalues. ERA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

N78-21904*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF BORON AND LITHIUM BY RECORDING THE PRODUCTS FROM (n, ALPHA) REACTIONS
Ye. M. Lobanov, B. P. Zverev, Yu. F. Simakhin, and M. M. Usmanova Mar. 1978 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk BSSR (USSR), v. 17, no. 11 p 1004-1006 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-2791)
(NASA-TM-75260) Avail: NTIS HC A02/MF A01 CSCL 20H

Irradiation with thermal neutrons in the VVR-S reactor provides a nondestructive method for determining the presence of boron and lithium in solids. The charged particles produced in the reactions Li-6(n,alpha)H-3 and B-10(n,alpha)Li-7 were detected using CsI single crystal. For alpha-particle spectrometry in the boron determination, an ionization chamber (W and Sn electrodes, 99% Ar + 1% H2) was developed allowing both absolute and relative measurements. In determining boron in lithium-containing samples, both scintillation and ionization chambers are used. In determining lithium in minerals, the error was 1.5%, and the sensitivity 0.00005 wt.%. In the determination of boron in SiC with a concentration of boron approximately (3 plus or minus 2) the error given by the alpha-range uncertainty was 15%. Author

N78-21905# Illinois Univ., Urbana-Champaign. Dept. of Electrical Engineering.
ELECTRON BEAM ADDRESSED ARRAYS OF INFRARED BOLOMETERS Final Report
O. L. Gaddy Dec. 1977 7 p refs
(Grant DAHC04-75-G-0122)
(AD-A049550; UILU-ENG-77-2270; ARO-13212.1-A-EL) Avail: NTIS HC A02/MF A01 CSCL 17/5

The results of research on infrared bolometric vidicons are described. The studies showed the feasibility of these devices

and that further study on target materials could produce potentially useful infrared image detecting devices. Author (GRA)

N78-21906# Los Alamos Scientific Lab., N. Mex.
GENERAL-PURPOSE HEAT SOURCE PROJECT, SPACE NUCLEAR SAFETY PROGRAM, AND RADIOISOTOPIC TERRESTRIAL SAFETY PROGRAM Progress Report, Sep. 1977
R. D. Baker, comp. Oct. 1977 55 p refs
(Contract W-7405-eng-36)
(LA-7003-PR) Avail: NTIS HC A04/MF A01

Studies related to the use of (Pu-238)O2 in radioisotopic power systems carried out by the Los Alamos Scientific Laboratory are discussed. The three programs involved are: general purpose heat source development, space nuclear safety, and radioisotopic terrestrial safety. ERA

74 OPTICS

Includes light phenomena.

N78-21907 California Univ., Berkeley.
OPTICAL QUADRUPOLE SUM FREQUENCY GENERATION IN METAL VAPOR Ph.D. Thesis
Donald Stimson Bethune 1977 85 p
Avail: Univ. Microfilms Order No. 77-31289

It is shown that second order nonlinear optical processes such as sum and difference generation can be observed in isotropic media, despite the fact that such processes are forbidden in the dipole approximation. A theoretical treatment of quadrupole sum and difference frequency generation is given, which includes the effects of spin-orbit splitting. The symmetry of the vapor is used to derive the form of the quadrupole susceptibility tensor, and the quadrupole moment tensor is then expressed as a scalar susceptibility multiplied by a tensor constructed directly from the input field polarization vectors. The expression shows that two non-collinear beams must be used. The effect of applying a magnetic field is derived. Expressions for phase matching and output power are found. Dissert. Abstr.

N78-21908 Catholic Univ. of America, Washington, D. C.
PARABOLIC PROFILING BY THE MOLECULAR STUFFING PROCESS Ph.D. Thesis
James Andrew Wilder, Jr. 1977 105 p
Avail: Univ. Microfilms Order No. 7802099

A process for the production of fibers whose dopant composition profiles can be described by a parabolic function which is maximum on the axis of the fiber is described. Initially, a silica base rod containing an interconnected porous structure is soaked in dopant solution. After the rod is uniformly 'stuffed' with dopant a predetermined variation of the dopant concentration in solution creates partial diffusion of dopant from the pores resulting in a particular index profile. A set of these concentration versus time boundary conditions were developed which, when applied to the diffusion equation, yielded near parabolic solutions. A numerical analysis of the solutions is presented and a technique for optimizing their parabolic behavior by proper choice of the concentration and time values of a particular boundary condition is discussed. Dissert. Abstr.

N78-21909 Oregon Graduate Center for Study and Research, Portland.
A SCANNING ION MICROSCOPE WITH A FIELD IONIZATION SOURCE Ph.D. Thesis
Jonathan Harris Orloff 1976 179 p
Avail: Univ. Microfilms Order No. 78-00058

The feasibility of using a field ionization (FI) source to produce fine focus ion beams was discussed. Operating parameters for a FI source have been measured and a source sensitivity of approximately 0.00005 A/sr/torr was found for both H2 and Ar at 77 K. The source is gas phase, differentially pumped with typical operating pressures of 1-0.03 torr at 77 K, resulting in a maximum source brightness approximately 10 to the 8th power A/sq cm/sr and angular intensity of approximately one millionth A/sr with beam energies of 10 - 20 keV. Angular distributions were measured and found to be uniform near theta = 0 deg, with the beam confined to plus or minus 20 deg. A scanning ion microscope (SIM) was built to further evaluate the source. Signal to noise ratio measurements on the source made at the specimen position show that the bulk of the noise power spectrum falls below f = 30 Hz. Dissert. Abstr.

N78-21910 Maine Univ., Orono.
INTERNAL REFLECTION OF BOUNDED BEAMS: EFFECTS IN THE PLANE OF INCIDENCE Ph.D. Thesis
Michael McGuirk 1977 181 p
Avail: Univ. Microfilms Order No. 78-01697

The effects which occur when a bounded electromagnetic beam is reflected at the interface between a medium of higher refractive index and a medium of lower refractive index are the Goos-Haenchen shift, the focal shift, and the angular shift were reported. These three effects provide an approximate description of the reflected electromagnetic field in terms of the incident beam and the geometry of the reflection. A new and more accurate method of calculating the Goos-Haenchen shift for beams of small diameter is presented. Measurements of the angular shift for Gaussian beams are reported. The measurements cover the range of incident angles from slightly less than Brewster's angle to slightly greater than the critical angle. The results are quite dependent on the polarization. Dissert. Abstr.

N78-21911 California Univ., San Diego.
AN INCOHERENT OPTICAL IMPLEMENTATION OF THE TWO-DIMENSIONAL WALSH TRANSFORM Ph.D. Thesis
Keith Bromley 1977 194 p
Avail: Univ. Microfilms Order No. 77-32796

A novel technique is discussed for performing the Walsh transformation on a live incoming image using simple passive optical elements. The technique employs a modification of the familiar lensless or shadow-casting correlator wherein the natural diffuseness of the incoming image is used to correlate it with a pair of reference transparencies. This optical system divides the image into subimages and generates the first 16 Walsh coefficients for all subimages in parallel. (actually, it is the Dillard transformation, a nonnegative version of the Walsh transformation, which is performed.) An experimental verification of the technique is performed and results are shown. Dissert. Abstr.

N78-21912 Oregon Univ., Eugene.
LIGHT SCATTERING AND BROWNIAN MOTION Ph.D. Thesis
Eddie Li Chang 1977 150 p
Avail: Univ. Microfilms Order No. 7802510

Light scattering experiments were done with Raman equipment. Laser light falls on a glass capillary holding the sample solution; the light at 90 degrees was collected by a double grating monochromator onto a photomultiplier tube and the resulting photoelectron pulses were amplified and counted. This experimental set up was particularly suited for situations where one needs to conserve the amount of sample expended. The two systems reported in this dissertation were purple membrane discs from halo bacterium halobium. In the former case the objective was to determine the experimental feasibility of seeing a light induced unimolecular reaction rate constant by light scattering, while in the latter case, a change in particle size was sought as a function of temperature. Dissert. Abstr.

N78-21913# Honeywell, Inc., Minneapolis, Minn. Systems and Research Center.
AUTOMATED IMAGE ENHANCEMENT TECHNIQUES FOR SECOND GENERATION FLIR Final Report
Dec. 1977 353 p refs
(Contract DAAG53-76-C-0195)
(AD-A049564; HONEYWELL-77SRC93) Avail: NTIS HC A16/MF A01 CSCL 17/5

The report presents the results of Phase I and Phase II studies in the application of image processing techniques to FLIR imaging systems. Part I describes the image enhancement algorithms investigated, their analysis, and preliminary design of the hardware to implement these functions. Part II presents the results of the human factors enhancement evaluation study, conducted as an adjunct to the above contract, in which the algorithms developed during this study were evaluated. Part III presents the development of a search effectiveness model for

predicting search performance using electrooptical sensors in tactical situations. Author (GRA)

N78-21914# Army Armament Research and Development Command, Aberdeen Proving Ground, Md. Chemical Systems Lab.
ANOMALOUS INFRARED EMISSION FROM CONDENSING AND COOLING STEAM CLOUDS Technical Report, Jun. 1976 - Sep. 1977
Hugh R. Carlon Dec. 1977 12 p refs
(DA Proj. 1T1-61101-A-91A)
(AD-A050083; AD-E400066; ARCSL-TR-78001) Avail: NTIS HC A02/MF A01 CSCL 20/6

The 10-micrometer wavelength, anomalous infrared emission from condensing and cooling clouds of saturated steam at atmospheric pressure was measured. Radiant emittance values were observed which were three to four times those calculated for water droplets and water vapor present in the clouds. Near 100 C, luminescence-like activity was observed confirming earlier observations by other workers. GRA

N78-21915# Hughes Research Labs., Malibu, Calif.
DIFFUSION PROCESS FOR FORMATION OF SINGLE-MODE WAVEGUIDE Final Report, 18 May - 18 Dec. 1977
Bor-Uei Chen Jan. 1978 34 p refs
(Contract N00173-77-C-0138)
(AD-A049558) Avail: NTIS HC A03/MF A01 CSCL 20/6

The objective of this program is two-fold: (1) study of channel waveguide formation in LiNbO3 and LiTaO3 by Ti metal diffusion including Li2O out-diffusion suppression and lateral diffusion suppression; (2) development of three-dimensional channel waveguide horns designed to provide higher end-fire coupling efficiency to large-core single-mode fibers. As a result of 1976 IR and D effort, we have developed a technique to eliminate Li2O out-diffusion waveguide by annealing the crystal in LiNbO3 powder. Under this program, a series of experiments were carried out to study the temperature and time dependence of this powder treatment. Three significant results were obtained. First, it is confirmed that up to 1% molecular weight of Li2O can be brought into the substrate surface layer through the powder treatment. Second, the compensation process (Li2O in-diffusion) may occur at temperatures 750 C or lower. Third, 80% of the compensation process can be obtained in one-half hour when the annealing temperature is 900 C. The fast reaction rate implies that the powder treatment may not be dominated by the diffusion process. Solid-solid surface reaction may play an important role in this process. Single-mode channel waveguides in LiNbO3 for this program were fabricated by diffusing Ti channels into Y-cut LiNbO3 wafers. GRA

N78-21916# Argonne National Lab., Ill.
QUANTITATIVE DETERMINATION OF SURFACE TEMPERATURES USING AN INFRARED CAMERA
C. K. Hsieh and W. A. Ellingson 1977 8 p Presented at 21st Ann. Techn. Symp. of the Soc. of Photo-Optical Instrumentation, San Diego, Calif., 22 Aug. 1977
(Contract W-31-109-eng-38)
(CONF-770868-2) Avail: NTIS HC A02/MF A01

A method is presented for determining the surface-temperature distribution at each point in an infrared picture. To handle the surface reflection problem, three cases are considered that include the use of black coatings, radiation shields, and band-pass filters. For uniform irradiation on the test surface, the irradiation can be measured by using a cooled, convex mirror. Equations are derived to show that this surrounding irradiation effect can be subtracted out from the scanned radiation; thus the net radiation is related to only emission from the surface. To provide for temperature measurements over a large field, the image-processing technique is used to digitize the infrared data. Procedures are described for using a computer to make point-by-point temperature calculations. A sample case is given to illustrate applications of the method. ERA

N78-21917# Los Alamos Scientific Lab., N. Mex.
HIGH-RESOLUTION SPECTROSCOPY USING TUNABLE DIODE LASERS: TECHNIQUES AND APPLICATIONS
Robin S. McDowell 1977 9 p refs Presented at Electro-Opt. Systems Conf., Anaheim, Calif., 27 Oct. 1977
(Contract W-7405-eng-36)
(LA-UR-77-2222; Conf-771040-5) Avail: NTIS HC A02/MF A01

Methods for generating tunable monochromatic infrared radiation are tabulated. Spectra of SF6 and OsO4 are discussed, including references to photodissociation and laser isotope separation. ERA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N78-21918 Wisconsin Univ., Madison.
THEORY AND SIMULATION OF THE STABILITY OF BERNSTEIN-GREENE-KRUSKAL WAVES Ph.D. Thesis
James Lawrence Schwarzmeier 1977 173 p
Avail: Univ. Microfilms Order No. 7719786

A linear stability analysis method for inhomogeneous Vlasov equilibria is described. From a simulation of the Vlasov-Poisson equations, single Bernstein-Greene-Kruskal equilibria are observed to be the time asymptotic state of homogeneous two-stream and negative mass instabilities. An infinite wavetrain is formed by placing the single BGK solutions end-to-end in the x-direction. When the wavetrain is perturbed periodically in x, the simulation program shows that the holes in phase space are unstable towards coalescence. The growth rate and shape of the normal mode of the instability are obtained from the simulation. The perturbed distribution is expanded in eigenfunctions of the Liouville operator, and the perturbed potential in eigenfunctions of a static field operator. Dissert. Abstr.

N78-21919 Princeton Univ., N. J.
DRIFT WAVES IN INHOMOGENEOUS PLASMAS WITH SHEAR AND TEMPERATURE GRADIENTS Ph.D. Thesis
Michael Anthony True 1977 120 p
Avail: Univ. Microfilms Order No. 78-00277

Magnetic shear has been shown to have a significant stabilizing effect on drift waves. The fluctuation level of the shear-stabilized modes are calculated using the Pearlstein-Berk nonlocal normal modes as expansion eigenmodes of a test particle in a slab geometry. The test particles are dressed in their screening clouds; then the dressed particles are superimposed as if they were statistically uncorrelated in order to evaluate the density and electric field fluctuations around a series of independent rational surfaces in a shear-stabilized slab. It was found that the fluctuation induced heat transfer and diffusion are less than classical. The scattering cross section (near instability onset) is greater than the classical Thomson cross section. Dissert. Abstr.

N78-21920 Cornell Univ., New York.
GENERATION AND BEHAVIOR OF LONG-LIVED FIELD REVERSING ELECTRON RINGS IN STRONG TOROIDAL FIELDS Ph.D. Thesis
Robert Alfred Meger 1977 240 p
Avail: Univ. Microfilms Order No. 7801666

Rings with overall fast electron lifetimes of up to 1.5 msec are described which show field reversals of up to 200% and field reversal times of up to 200 microseconds. This represents an improvement of nearly a factor of 50X over the rings trapped on the smaller E-ring devices. The second experiment details a 4 mm microwave interferometer measurement of the E-ring background plasma density. It shows the equilibrium density to be consistent with the production and recombination of plasma in the high (> 10 to the 15th power/cubic centimeter) background neutral density. Finally, it shows the description of an experiment where the normally strong toroidal field is allowed to decay away faster than the ring trapped current. A series of anomalous losses is shown to appear which seems to depend only on the toroidal field and the ring self-field. Dissert. Abstr.

N78-21921 Colorado State Univ., Fort Collins.
THEORY OF LARGE AGGLOMERATES IN MAGNETIC COLLOIDS Ph.D. Thesis
Wei-Hsi Liao 1977 78 p

Avail: Univ. Microfilms Order No. 7802381

A new and different theoretical model for large agglomerates was constructed in this paper. The macroscopic properties of agglomerates which were undergoing gravitational settling can be found by assuming marginal hydrodynamic equilibrium and minimizing of energy. The results from this hydrodynamic model are compared with experimental measurements. The agreement was satisfactory. The model gives a better understanding of the agglomeration phenomena in ferrofluids than that of the thermal model. Dissert. Abstr.

N78-21922*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF ANODE-CATHODE GEOMETRY ON PERFORMANCE OF THE HIP-1 HOT ION PLASMA

Milton R. Lauver Apr. 1978 25 p refs

(NASA-TP-1201; E-9386) Avail: NTIS HC A02/MF A01 CSCL 20I

Hot-ion hydrogen plasma experiments were conducted in the NASA Lewis HIP-1 magnetic mirror facility to determine how the ion temperature was influenced by the axial position of the cathode tips relative to the anodes. A steady-state EXB plasma was formed by applying a strong radially inward dc electric field near the throats of the magnetic mirrors. The dc electric field was created between hollow cathode rods inside hollow anode cylinders, both concentric with the magnetic axis. The highest ion temperatures, 900 eV, were attained when the tip of each cathode was in the same plane as the end of its anode. These temperatures were reached with 22 kV applied to the electrodes in a field of 1.1 tesla. Scaling relations were empirically determined for ion temperature and the product of ion density and neutral particle density as a function of cathode voltage, discharge current, and electrode positions. Plasma discharge current vs voltage (I-V) characteristics were determined. Author

N78-21923# Naval Research Lab., Washington, D. C. Plasma Physics Div.

A THEORY OF ELECTRON ENERGY CONFINEMENT IN TOKAMAKS Interim Report

W. M. Manheimer and Thomas Antonsen, Jr. Oct. 1977 30 p refs

(Contract ES-77-A-01-6021)

(AD-A049505; AD-E000093; NRL-MR-3551) Avail: NTIS HC A03/MF A01 CSCL 20/9

A one dimensional thermal transport code has been employed to study electron energy confinement in Tokamaks. At each time step of the computations each point in the profile is examined to determine whether it is linearly stable to either the dissipative trapped electron mode or the internal kink and tearing modes. If the point is determined to be unstable an anomalously large electron thermal conductivity is turned on in the vicinity of that point. The electron temperature profile is found to relax to a marginally stable state. Our code predicts the scaling of confinement time with density in Alcator, and the scaling of temperature half-width with a qA in TFR. Author (GRA)

N78-21924*# Naval Research Lab., Washington, D. C. Plasma Physics Div.

IONIZATION EQUILIBRIUM AND RADIATIVE ENERGY LOSS RATES FOR C, N, AND O IONS IN LOW-DENSITY PLASMAS Interim Report

V. L. Jacobs, J. Davis, J. E. Rogerson, and M. Blaha Nov. 1977 17 p refs Sponsored by NASA

(NASA-CR-156068; AD-A050093; AD-E000088; NRL-MR-3572) Avail: NTIS HC A02/MF A01 CSCL 20/9

The results of calculations of the ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas are presented for electron temperatures in the range 10,000 to 10,000,000 K (about 1 to 1000 eV). The ionization structure is determined using the steady-state corona model, in which electron impact ionization from the ground states is balanced by direct radiative and dielectronic recombination. Using an improved theory, detailed calculations are carried out for the dielectronic recombination rates in which account is taken of all radiative and autoionization processes involving a single-electron electric-dipole transition of the recombining ion. The radiative energy loss processes considered are electron-impact excitation of resonance line emission, direct radiative recombination, dielectronic recombination, and electron-ion bremsstrahlung. For all three elements, resonance line emission resulting from 2s - 2p transitions produces a broad maximum in the energy loss rate near 100,000 K (about 10 eV). Author (GRA)

N78-21925# Polytechnic Inst. of New York, Brooklyn. Dept. of Electrical Engineering and Electrophysics.

STUDIES OF PARAMETRIC DECAY INSTABILITIES IN MAGNETO PLASMAS Final Scientific Report, Apr. 1974 - Jun. 1977

Szu-Ping Kuo and Bernard R-S Cheo Jun. 1977 94 p refs (Grant AF-AFOSR-74-2668)

(AD-A049547; POLY-EE/EP-77-207; AFOSR-78-0033TR) Avail: NTIS HC A05/MF A01 CSCL 20/9

A theory is developed for the parametric excitation of coupled waves in a uniform magneto plasma. Instead of using electrostatic approximation which is valid only for longitudinal waves, a general formulation of the parametric coupling equations is developed by using the Hamiltonian approach. The plasma is pumped by a monochromatic electromagnetic wave with frequency which decays into two decay waves (e.g., a plasmon and a phonon). Either one of the plasma modes coupled with the pump wave (through the linearized Vlasov equation) to induce a polarization may act as the source of another mode. A general procedure to calculate the induced polarizations is introduced by transforming the linearized Vlasov equation into the oscillating frame of reference, in which the equation can then be solved by the method of characteristics. The threshold power, initial growth rate, and the frequency shift (due to finite initial growth rate) of the parametric instabilities can be obtained from the coupled mode equations and the results obtained can be applied to all the wavelength region. Several interesting cases are presented and compared favorably with experiments. The simultaneous excitation of second harmonic of electron-cyclotron and electrostatic ion-cyclotron oscillations by means of a monochromatic electromagnetic wave at omega sub O - 9.23 GHz has been observed experimentally. GRA

N78-21926# Mathematical Sciences Northwest Inc., Bellevue, Wash.

HIGH THERMAL EFFICIENCY, RADIATION-BASED ADVANCED FUSION REACTORS Final Report

R. T. Taussig Apr. 1977 131 p refs

(EPRI-ER-544) Avail: NTIS HC A07/MF A01

An energy conversion scheme was explored which had the potential of achieving thermal cycle efficiencies high enough (e.g., 60 to 70 percent) to make advanced fuel fusion reactors attractive net power producers. A radiation boiler admitted a large fraction of the X-ray from the fusion plasma through a low-Z first wall into a high-Z working fluid where the energy was absorbed at temperatures of 2000 K to 3000 K. The hot working fluid expanded in an energy exchanger against a cooler, light gas, transferring most of the work of expansion from one gas to the other. This scheme was applied to the case of an advanced fuel proton-boron-11 fusion reactor using a single reheat topping and bottoming cycle. The operation of the radiation boiler and energy exchanger were both described. Material compatibility, X-ray absorption, thermal hydraulics, structural integrity, and other technical features of these components were analyzed to make a preliminary assessment of the feasibility of this concept. ERA

N78-21927# Electric Power Research Inst., Palo Alto, Calif.

FOUR WORKSHOPS IN ALTERNATE CONCEPTS IN CONTROLLED FUSION. PART A: EXECUTIVE SUMMARIES. PART B: EXTENDED SUMMARIES. PART C: CTR USING THE p-B-11 REACTION

John M. Dawson and Francis F. Chen, ed. May 1977 256 p refs Workshops held at Palo Alto, Calif., 13-14 Aug., 9-10 Sep. 1975, 23-24 Feb. and 8-9 Mar. 1976

(EPRI-ER-429-SR-Pt-A; EPRI-ER-429-SR-Pt-B; EPRI-ER-429-SR-Pt-C) Avail: NTIS HC A12/MF A01

A review has been completed of fourteen alternate fusion reactor concepts that could lead to more practical power plants. These concepts are in addition to the Tokamak and mirror concepts which are presently receiving the bulk of the U.S. R and D effort. The concept characterizations were assembled by means of workshops and are presented in two sets of summaries. Part A is a concise executive summary written in nontechnical

language and suitable for reading by executives who do not require a discussion of scientific details. A longer, more technical summary is presented in Part B. Part C deals specifically with the use of advanced fuel cycles (those that avoid the breeding of tritium and the materials damage by 14 MeV neutrons) and gives an illustration of a possible technique for achieving neutronless fusion energy. ERA

N78-21928# California Univ., Livermore. Lawrence Livermore Lab.
DESIGN OF AN ELECTROSTATIC END-PLUGGED PLASMA-CONFINEMENT DEVICE
R. W. Moir, T. J. Dolan, and W. L. Barr 27 Sep. 1977 8 p refs Presented at the 7th Symp. on Fusion Res. Proj., Knoxville, Tenn., 25-28 Oct. 1977
(Contract W-7405-eng-48)
(UCRL-79880; Conf-771029-49) Avail: NTIS HC A02/MF A01

A laboratory scale experimental device having an outside diameter of 1.2 m was designed to test the ideal of electrostatic end plugging of an open-ended magnetic field configuration. The configuration was a toroidal quadrupole having four very thin (less than 1 mm thick) line cusps produced by four circular copper coils. Iron was used to concentrate the magnetic flux density to 2.0 T; without the use of iron, the power consumption, which is about 1 MW, would be about 25 times higher. The use of iron also produced a precisely known magnetic field and allowed good access for diagnostics and pumping. Iron was also used for both the flux return path and the vacuum chamber. A hollow anode with an adjustable (nominally 1 mm wide) gap was based from 10 to 20 kV. ERA

N78-21929# Oak Ridge National Lab., Tenn. Fusion Energy Div.
STUDY OF POSSIBLE SEPARABLE SOLUTIONS FOR PLASMA TRANSPORT IN OHMICALLY HEATED TOKAMAKS
Tanner Uckan Oct. 1977 29 p refs
(Contract W-7405-eng-26)
(ORNL/TM-6065) Avail: NTIS HC A03/MF A01

The transport problem was investigated analytically with the separation of the varibles time, t, and rho = r(2)h(+), where r was the space coordinate and h(t) is only a function of time. This investigation examined the circumstances under which these analytical solutions were possible. The time evolution of the current density and temperature profiles was then obtained for a simple plasma model which included the electric field diffusion and heat conduction losses. Expressions were also given for plasma discharge parameters such as the time evolution of the safety factor, the plasma current, the poloidal flux function, the skin time, the poloidal beta, the transformer flux, and the electron energy lifetime. The results were then applied to a typical size Tokamak device. ERA

N78-21930# Princeton Univ., N. J. Plasma Physics Lab.
NUMERICAL SIMULATIONS OF COLLISIONLESS DRIFT INSTABILITIES FOR LOW-DENSITY PLASMAS
W. W. Lee, Y. Y. Kuo Yau (TRW Systems, Redondo Beach, Calif.), and H. Okuda Oct. 1977 47 p refs
(Contracts EY-76-C-02-3073; F44620-C-0033)
(PPPL-1382) Avail: NTIS HC A03/MF A01

Nonlinear behavior of the collisionless drift instabilities were studied for the universal and current driven modes by means of electrostatic particle simulations in two-and-a-half dimensions. Realistic mass ratios of the electrons to the ions were used in the simulations, where the guiding center approximation for the electrons and the exact dynamics for the ions were employed. Several nonlinear effects including the quasilinear diffusion of the particle density, the frequency shift due to the ambipolar field, the mode competition among the unstable waves, and the quasilinear diffusion in the velocity space were found to be the dominant mechanisms for the saturation. The stabilization of the collisionless drift instabilities by the magnetic shear was also studied. ERA

N78-21931# Scientific Translation Service, Santa Barbara, Calif.
SELF-STABILIZATION OF A HIGH PRESSURE PLASMA IN TOROIDAL CONTAINERS WITH AN ARBITRARY SHAPE FOR THE MAGNETIC AXIS
Kh. D. Aburdzhaniya and A. B. Mikhailovskii Aug. 1977 26 p refs Transl. into ENGLISH of "Samostabilizatsia Plazmy Bolshovo Davleniya v Toroidalnykh Lovushkakh s Proizvolnoi Formoi Magnitnoi Osi" from unidentified Russian source Prepared for DOE
(ERDA-TR-311) Avail: NTIS HC A03/MF A01

A stability criterion was obtained for a high pressure plasma in toroidal magnetic enclosures with a circular cross section, and with an arbitrary magnetic axis. This criterion is applied in an analysis of the stability of certain actual systems. It is shown that, in these systems, a self-stabilization effect occurs along with increasing pressure. ERA

N78-21932# Scientific Translation Service, Santa Barbara, Calif.
INDUCED OSCILLATION INSTABILITIES AND THEIR ROLE IN TOKAMAKS WITH INJECTED NEUTRAL PARTICLES
V. A. Mazur, A. B. Mikhailovskii, A. L. Frenkel, and I. G. Shukhman Aug. 1977 35 p refs Transl. into ENGLISH of "Neustoichivosti Nesobstvennykh Kolebaniiy i Ikh Rol v Probleme Tokamaka s Inzhektsiei Neitralov" from unidentified Russian source Sponsored by ERDA
(ERDA-TR-312) Avail: NTIS HC A03/MF A01

Instabilities related to the buildup of induced oscillations in an inhomogeneous plasma were studied. Such instabilities under actual conditions may play a more important role than the instabilities which have usually been studied and which are related to natural oscillations. The general concepts of induced oscillation instabilities are applied to a Tokamak injected with neutral particles. Because of the presence of instabilities related to the build-up of induced oscillations, the plasma in the Tokamak should be more unstable than has been predicted by the work of Rosenbluth and Rutherford. ERA

N78-21933# Scientific Translation Service, Santa Barbara, Calif.
BOUNCE EFFECTS IN THE INSTABILITY THEORY OF TRAPPED ALPHA PARTICLES IN THE TOKAMAK REACTOR
T. D. Kaladze and A. B. Mikhailovskii Aug. 1977 20 p refs Transl. into ENGLISH from Bauns-Effekty v Ieorii Neustoichivosti zapertykh Alifa-Chastis b Reaktore-Tokamake (USSR)
(ERDA-TR-313) Avail: NTIS HC A02/MF A01

A theoretical investigation was made of the role of bounce resonances during the cyclotron build up of high speed magneto-acoustic waves with trapped alpha particles in the Tokamak reactor. It is shown that bounce resonances can lead to an additional increase in the incremental of high-speed magneto-acoustic waves in an amount on the order of 0.5 (epsilon omega/sub Bs//omega/sub b/)/sup 1/3/, where omega/sub BS/ is the alpha particle cyclotron frequency averaged over the magnetic surface, omega sub b/ is the alpha particle bounce frequency, and epsilon is the ratio of the smaller radius of the Tokamak to the larger. ERA

N78-21934# Scientific Translation Service, Santa Barbara, Calif.
TOKAMAK IMPURITY INSTABILITIES
A. B. Mikhailovskii and I. G. Shukhman Aug. 1977 13 p refs Transl. into ENGLISH of "O Primesnykh Neustoichivostyakh v Tokamake" from unidentified Russian source Sponsored by ERDA
(ERDA-TR-314) Avail: NTIS HC A02/MF A01

Tokamak impurity instabilities were studied. Two types due to the presence of trapped ions were studied. It was shown that these instabilities were slightly sensitive to shear, and therefore they should be of interest in the problem of the dynamics of impurities in the Tokamak. ERA

N78-21935# Oak Ridge National Lab., Tenn. Fusion Energy Div.
EFFECTS OF GLOBAL FIELD ERRORS ON ELMO BUMPY TORUS
B. H. Quon, R. A. Dandl, P. L. Colestock (Rensselaer Polytech. Inst.), and H. Ikegami (Nagoya Univ., Japan) Oct. 1977 19 p refs
(Contract W-7405-eng-26)
(ORNL/TM-6075) Avail: NTIS HC A02/MF A01

The plasma sensitivity to magnetic field error effects was tested experimentally using externally introduced global field errors

in the ELMO Bumpy Torus (EBT). A critical field (delta B/sub r//B)/sub cr/ approximately 0.0006-0.001 was observed, below which the plasma is essentially free from convective cells, toroidal currents, and instabilities. The observed critical value is comparable to a neoclassical critical field error (delta B/sub r//B)/sub cr/ approximately equal to rho/R, the ratio of the ion Larmor radius to the major radius of the torus. ERA

N78-21936# California Univ., Livermore. Lawrence Livermore Lab.
SOME HIGHLIGHTS OF THEORETICAL AND COMPUTATIONAL PLASMA PHYSICS, PART 2
Brendan McNamara 11 Aug. 1977 59 p refs Presented at the Summer Coll. on Phys. and Contemp. Needs, Nathiagali, Pakistan, 20 Jun. - 8 Jul. 1977
(Contract W-7405-eng-48)
(UCRL-79600-Pt-2) Avail: NTIS HC A04/MF A01

The difficult nature of various equations for plasma physics and dynamics is discussed as well as present understanding of the nonlinear consequences of the equations. The comments, which are illustrated with computational studies, aim to describe equilibria, stability of the equilibria, and the transport of energy and particles out of the plasma. ERA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N78-21937 California Univ., Berkeley.
NONLINEAR OPTICAL EFFECTS IN LIQUID CRYSTALS Ph.D. Thesis
Eric Gregory Hanson 1977 135 p
Avail: Univ. Microfilms Order No. 7731386

It is shown that various characteristic parameters of nematic liquid crystals can be determined by a combination of linear and nonlinear optical measurements. Such measurements were made on seven homologous compounds of the p,p'-di-n-alkoxy-azoxybenzene series, allowing the determination of variations in these parameters with increasing alkyl chain length. In the isotropic phase, the temperature dependence of the optical Kerr constant and the orientational relaxation time were measured. In the nematic phase, the temperature dependence of the refractive indices and the linear birefringence of the same seven compounds were measured. It is shown that it is possible to use a single liquid crystalline material in its isotropic phase to study the entire range of self-focusing behavior from transient to quasi-steady-state. The results agree well with a simple unified physical description of self-focusing and with known theoretical predictions. Stimulated Brillouin scattering in the backward direction is identified as the mechanism responsible for the limiting diameter of the self-focused beam in the experiment. Dissert. Abstr.

N78-21938 Stanford Univ., Calif.
RESPONSE FUNCTIONS IN A ONE-DIMENSIONAL FERMI GAS AND RENORMALIZATION-GROUP TREATMENT OF ONE-DIMENSIONAL KONDO LATTICES Ph.D. Thesis
Joseph Newton Fields, III 1977 99 p
Avail: Univ. Microfilms Order No. 78-02157

The first section of this work reported a calculation of the response functions of the one dimensional Fermi gas with backscattering interactions, which was proposed as a model for quasi-one-dimensional materials such as tetrathiafulvalene tetracyanoquinodimethane and potassium cyanoplatinate. These functions were calculated using an equivalence of the spin-density part of the Fermi Hamiltonian to the Sine-Gordon Hamiltonian. Also presented was a study of one dimensional analog of the Kondo lattice problem, in which an electron conduction band interacts with a localized magnetic moment in each cell of a lattice. The calculation is accomplished using a renormalization-group technique which is a real-space generalization.
Dissert. Abstr.

N78-21939 State Univ. of New York, Stony Brook.
CRITICAL PHENOMENA OF INHOMOGENEOUS ISING MODELS Ph.D. Thesis
John Richard Hamm 1977 134 p
Avail: Univ. Microfilms Order No. 78-00408

The thermodynamics of a square Ising lattice which is constructed from unit cells of height n lattice spacings and width m lattice spacings were considered. In a particular unit cell the values of the 2mn exchange energies can be chosen at will. For arbitrary n and for m=2 and m=3 the exact equation for the critical point was obtained. It was shown that when n is finite and m=1 or m=2 the specific heat had a singularity of the form Aln absolute value of 1-T/T sub c and an explicit formula for A was derived. In the same model for m=2 and h=infinity the critical temperature was computed for when the vertical bonds in the unit cell were independently distributed random variables. Using the theory of random matrix products it was shown that the critical temperature of the random lattice depends only on the probability density function for the vertical bonds. For a probability density of width proportional to N to the -1, an explicit formula for T sub c correct to order N to the -2 was derived. This result depended only on the first and second moments of the distribution functions for the vertical bonds.
Dissert. Abstr.

N78-21940 Virginia Polytechnic Inst. and State Univ., Blacksburg.
QUASICLASSICAL METHODS IN THE LINEAR HEISENBERG MODEL Ph.D. Thesis
James Francis Hopkinson 1977 183 p
Avail: Univ. Microfilms Order No. 78-01586

An isomorphic mapping procedure (spin Wignerization) in which quantum mechanical spin matrices are mapped onto unit vectors is utilized to obtain corrections to the classical results for the partition function, magnetic internal energy, specific heat, susceptibilities for a one dimensional lattice of spins coupled by a nearest neighbor, isotropic Heisenberg Hamiltonian. Analysis of the linear Heisenberg antiferromagnetic tetramethylmanganese-ammoniumtrichloride in the context of quantum corrected classical theory is given. Second order corrections indicate that there exists deviations from classical behavior for this compound. Nonetheless classical thoery is found to fit the data well, even down to temperatures of 1.1 K where quantum effects are expected to be significant. It is concluded that a low temperature quasiclassical expansion is required to better understand this phenomenon. An initial program in this regard is presented.
Dissert. Abstr.

N78-21941 California Univ., San Diego.
CHARACTERIZATION OF SURFACES BY LOW ENERGY HELIUM SCATTERING Ph.D. Thesis
James Monroe Horne 1977 106 p
Avail: Univ. Microfilms Order No. 7800778

Low energy (11meV-63meV) helium scattering was used in probing the surface properties of three metals, two epitaxial crystals, Ag(111) and Au(111) and a polycrystalline W(100). Quantum conservation equations for low energy atomic scattering were presented in three commonly used experimental coordinate systems. These equations accounted for gas particle energy exchange with surface phonons and gas particle diffraction from an arbitrary two-dimensional surface lattice. The equations for selective adsorption were also presented. An experimental apparatus, a UHV to 10 to the minus 10 torr system, is described which permits excellent sensitivity and energy resolution in atomic and molecular surface scattering experiments. Dissert. Abstr.

N78-21942 Northwestern Univ., Evanston, Ill.
THE FERMI SURFACE OF NIOBIUM Ph.D. Thesis
Douglas Phillip Karim 1977 140 p
Avail: Univ. Microfilms Order No. 7800720

Data were taken at temperatures as low as .3 K and in fields as high as 130 kG. An online minicomputer was used to Fourier transform the digitized signals. Many new extremal area data were obtained including oscillations associated with the previously unobserved gamma-centered hole octahedron and gamma and N centered orbits on the so called jungle gym. A separate low frequency signal was observed and is believed to be a result of magnetic breakdown induced quantum interference oscillations. Anisotropies of the cyclotron effective mass were determined for many orbits on all three of the Fermi surface sheets. Finally, the area data were used to parametrize the Fermi

surface in terms of scattering phase shifts in a KKR band structure formalism. Dissert. Abstr.

N78-21943 Hawaii Univ., Honolulu.
PRESSURE DEPENDENCE OF THE ELASTIC MODULI OF BODY-CENTERED-CUBIC TRANSITION METALS Ph.D. Thesis
Keith Wayne Katahara 1977 151 p
Avail: Univ. Microfilms Order No. 7801050

The single crystal elastic moduli, C sub ij, and their pressure derivatives, dC sub ij/dP, were measured ultrasonically at 25 C for body-centered-cubic Ti-V-Cr, Nb-Mo, and Ta-W solid solutions. The results of this study showed that changes in the composition dependence of the C sub ij and, particularly, the dC sub ij/dP appeared to be related to topological changes in the Fermi surface which occured as the electron population varied in the rigid-band model. The relationship between the band structure and the C sub ij was discussed and a qualitative explanation was given for the correlations between the moduli and the Fermi surface. Sources of error in the ultrasonic measurements were considered in detail. The results were also compared to other ultrasonic measurements and to X-ray and shock-wave compression experiments. Dissert. Abstr.

N78-21944 California Univ., San Diego.
LONG RANGE INTERACTIONS BETWEEN ATOMS ABSORBED ON SURFACES Ph.D. Thesis
King-Hon Lau 1977 108 p
Avail: Univ. Microfilms Order No. 7802109

Mechanisms for the long range, indirect interaction between two atoms absorbed on a solid surface discussed include: dipole-dipole interaction between two adatoms; the interaction between two adatoms mediated by the elastic disortion of the substrate, and the oscillatory part of the indirect interaction between two adatoms on a metal. Comparisons are made with the numerical calculations by Einstein and Schrieffer.
Dissert. Abstr.

N78-21945 Illinois Inst. of Tech., Chicago.
GENERATION AND DETECTION OF MICROWAVE PHONONS IN N-TYPE INDIUM ANTIMONIDE Ph.D. Thesis
Johnson Lee 1977 151 p
Avail: Univ. Microfilms Order No. 7800871

The intensity of transmitted light at a wavelength near 10 micron m in n-InSb at 100 K was periodically modulated in the presence of a dc electric current. The size of the oscillations in the transmitted light increased with the strength of the electric field and with the distance from the cathode to the point where the laser beam was focused. The periodicity of the modulation changes with sample length, electric field strength, wavelength of the laser, and orientation of the sample. Evidence to show that this phenomenon is correlated with the amplification of high frequency phonons (greater than 20 GHz) is presented.
Dissert. Abstr.

N78-21946 California Univ., Irvine.
THEORETICAL STUDIES OF OPTICAL PHENOMENA IN SOLIDS Ph.D. Thesis
Billy Gene Martin 1977 209 p
Avail: Univ. Microfilms Order No. 7802429

Investigations were carried out in the general area of optical phenomena in solids for the following topics: (1) the effects of high magnetic fields on degenerate band excitons in InSb, (2) the theory of bound states associated with n-type inversion layers on silicon (001) surfaces, (3) calculations to obtain the dispersion curve for surface polaritons in germanium, (4) surface polariton relation for n-type InSb in the presence of a dc electric current and an external dc magnetic field, and (5) surface polaritons associated with the extreme anamalous limit in superconductors. Dissert. Abstr.

N78-21947 State Univ. of New York, Stony Brook.
INTRINSIC FLUCTUATION OF THIN FILM MICROBRIDGES Ph.D. Thesis
Tsung-Wen Lee 1977 147 p
Avail: Univ. Microfilms Order No. 7800405

The dynamic resistance and the voltage noise power of thin film microbridges are measured using an improved technique. For 1000 A thick indium bridges with dimensions smaller than 0.5 micron wide and 0.5 micron long, the I sub c peak of the dynamic resistance is found to decrease with decreasing temperature except when very close to T sub C, provided that the bridges are evaporated in a good vacuum of 2 to 3 times 10 to the -7th power torrs. For other larger and maybe dirtier bridges, the I sub c peak increases with decreasing temperature and evolves hysteresis at lower temperatures. For short bridges, the wider bridges have the I sub c peak grown up and become hysteretic at higher temperatures. For narrow bridges, the longer bridges have the I sub c peak grown up and become hysteretic at higher temperatures. Dissert. Abstr.

N78-21948 Stanford Univ., Calif.
PHOTOEMISSION STUDIES OF LAYERED TRANSITION METAL DICHALCOGENIDES Ph.D. Thesis
Joseph Charles McMenamin 1977 60 p
Avail: Univ. Microfilms Order No. 7802200

Ultraviolet photoemission spectroscopy (UPS) was used to study the valence band electronic structure of 2H-MoS2 and several other layered transition metal dichalcogenide (TX2) compounds. Electronic structure models were deduced from the UPS data and compared with other models and calculations. The UPS data were combined with other reported data, and a rather complete band model for MoS2 was developed. Two key points of this model are a semiconducting band gap in excess of 1 eV and an overlap of the two valence bands. In an appendix the effects of contamination on the MoS2 surface are discussed. Data taken on air-cleaved samples show the inertness of the MoS2 surface resulting from a two dimensional structure with no dangling bonds. Dissert. Abstr.

N78-21949 Oregon Graduate Center for Study and Research, Portland.
STRUCTURAL AND MAGNETIC STUDIES OF SELECTED RARE EARTH INTERMETALLICS Ph.D. Thesis
Duane Ray McNeely 1976 184 p
Avail: Univ. Microfilms Order No. 7800057

Various Rx(T,E)y and (R,E)xTy alloys are studied, where R is Yttrium or a rare earth element, T is a 3d transition metal and E is an element to be substituted for either R or T. These alloys were studied with respect to structural stability, magnetic hardness, and saturation magnetization. In the case of Sm.105Fe.896-xAlx with x = 0.0 to 0.5, the Curie temperature (Tc) versus composition was investigated. The structural stabilities of the compounds investigated were considered on the basis of geometrical and deformable sphere packing factors. The nearest neighbor diagram was developed with respect to these factors. The role of the Ruderman, Kittel Kasuya and Yosida (RKKY) exchange interaction in describing the magnetic properties of these alloys was also considered. Dissert. Abstr.

N78-21950 Yeshiva Univ., New York.
ELECTROREFLECTANCE IN SEMICONDUCTORS AND ITS APPLICATION AS A METHOD OF MATERIALS CHARACTERIZATION Ph.D. Thesis
Cajetan Ezeani Okeke 1977 175 p
Avail: Univ. Microfilms Order No. 7732535

A unique technique for the investigation of topographical variations in impurity concentration delta N/N across the surface of silicon and GaAs, using both electrolyte electroreflectance (EER) and transverse electroreflectance (TER). The materials investigated include the following: N+ on p diffused silicon solar cell; high purity vapor phase epitaxy grown GaAs and high resistivity Cr-GaAs. The same general technique was utilized in a different context for measuring the local composition x as a function of position on the surface of semiconductor alloys. The technique is marked by the following good qualities: inexpensive, high spatial resolution, high sensitivity, reproducibility and nondestructiveness. Using the photoconductive decay technique, the minority carrier lifetime of several samples of silicon at room temperature was measured with pulsed ruby laser as a light source. Dissert. Abstr.

N78-21951 California Inst. of Tech., Pasadena.
SUPERCONDUCTIVITY, SPIN-GLASS PROPERTIES, AND FERROMAGNETISM IN AMORPHOUS La-Gd-Au ALLOYS Ph.D. Thesis

Siu Joe Poon 1978 84 p
Avail: Univ. Microfilms Order No. 7801534

The superconducting and magnetic properties of splat cooled amorphous La-Gd-Au alloys were studied. The concentration range where superconductivity and spin-glass freezing might coexist was investigated. In the absence of complications due to crystal field and enhanced matrix effect, a phenomenological model is proposed in which the magnetic clusters are treated as single spin entities interacting via random forces using the molecular field approach. The fundamental parameters (such as the strength of the forces and the size of clusters) can be deduced from magnetization measurements. The remanent magnetization is shown to arise from an interplay of the RKKY and dipolar forces. Magnetoresistivity results are found to be consistent with the aforementioned picture. The nature of magnetic interactions in an amorphous matrix is also discussed. Dissert. Abstr.

N78-21952 Notre Dame Univ., Ind.
QUASIPARTICLE INTERFERENCE EFFECTS IN THE TUNNELING CHARACTERISTICS OF THICK SUPERCONDUCTING FILMS OF ZINC Ph.D. Thesis
Lanshu Wong 1978 153 p
Avail: Univ. Microfilms Order No. 7800560

Thick Zn films (1-6 microns) backed with superconducting Pb produce ac tunneling characteristics containing oscillatory structure which results from bound-state and virtual-state levels formed by Andreev scattering of tunneling quasiparticles at the Pb/Zn interface. Level structure observed with Pb/Zn-ZnOx-Al junctions provides a sensitive and direct probe for studying certain aspects of the electron-phonon interaction in Zn. By extending Wolfram's theory to include effects of nonzero mean free path in the underlayer (overlayer), as well as effects due to a spatially varying energy gap, one can show that neither of these factors is expected to exert much influence on the agreement between experiment and theory. Dissert. Abstr.

N78-21953 California Univ., San Diego.
PROSPECTS FOR STUDYING GAS CHEMISORPTION KINETICS USING CURRENT FLUCTUATIONS Ph.D. Thesis
Gopa Sarker De 1977 134 p
Avail: Univ. Microfilms Order No. 78-00772

Changes in the current noise induced by chemisorption on the surface of a thin film in the presence of an applied field were investigated. The zero voltage part of the noise spectrum is the appropriate Josephson noise. The part varying as the square of the voltage (in the lowest order nonequilibrium term) carries the information about surface reaction kinetics. Effects of the adatoms on the current are considered as part of the adiabatic limit. The driven part of the correlation function reduces to an absorbate density autocorrelation for times comparable to the reaction constant. The density correlation function is evaluated using the Fokker-Planck equation for the adsorbate distribution function. The case of multistage reaction is also explored. Dissert. Abstr.

N78-21954 Stanford Univ., Calif.
STATIC AND DYNAMIC TEXTURES IN SUPERFLUID He-3 Ph.D. Thesis
Louis James Buchholtz 1977 154 p
Avail: Univ. Microfilms Order No. 7802138

The experimental properties of superfluid He-3 display a strong dependence on the shape and size of a sample's bounding walls. Included among these properties are static ones, such as the magnetic susceptibility, and dynamic ones such as the NMR absorption. These characteristics are examined through a Ginzburg-Landau expansion of the free energy in powers of the pairing amplitude. The expansion, valid near the critical temperature, allows a variational determination of the equilibrium states starting from various physically motivated forms for the order parameter. In order to include the effects of curvilinear boundaries more simply, the entire formalism is expressed in a generalized coordinate notation. The usefulness of the method is demonstrated by its application to the case of cylindrical boundaries. Dynamic phenomena are studied through a generalization of Leggett's phenomenological equations to inhomogeneous samples. Dissert. Abstr.

N78-21955 Cornell Univ., New York.
CHEMISORPTION AND REACTION MECHANISMS ON IRON AND IRIDIUM SURFACES Ph.D. Thesis
Charles Frederick Brucker 1977 172 p
Avail: Univ. Microfilms Order No. 7801610

Crystal surfaces are studied for a variety of catalytically interesting organic and inorganic molecules, including oxygens, carbon monoxide, nitric oxide, acetylene, and ethylene. The overall approach to the study of these interacting systems involves the combined use of ultraviolet photoemission spectroscopy (UPS), low-energy electron diffraction (LEED), Auger Electron spectroscopy (AES), and thermal desorption spectroscopy (TDS) to clarify the microscopic nature of surface chemical binding and reaction. The application of polarized, tunable synchrotron radiation to the investigation of photoemission cross section behavior for the system carbon monoxide on Ir(100)-(5x1) and (111) surfaces is described. Dissert. Abstr.

N78-21956 Pennsylvania State Univ., University Park.
ENERGY TRANSFER AT SOLID SURFACES Ph.D. Thesis
Clifton Walk Draper 1977 154 p
Avail: Univ. Microfilms Order No. 7803319

A radiation pyrometer technique was used to measure the thermal emittances of Al, Fe, Ti 318 alloy, and of As, Sb, and Bi(111) cleavage surfaces and those of poylcrystalline and oxidized As (111). Thermal diffusivities of group V semimetals were determined by using the heat from a laser pulse to irradiate wafers f polycrystalline and oriented (111) As, Sb, and Bi. Both translational and internal accommodation coefficients were determined for a variety of polyatomic gases on metal and semimetal surfaces. The experiments in each area are separated, but the areas are interrelated through the energy balance of the gas-surface energy exchange. Dissert. Abstr.

N78-21957*# National Aeronautics and Space Administration, Washington, D. C.
NOVEL SILICON CRYSTALS AND METHOD FOR THEIR PREPARATION
B. Authier Sep. 1977 12 p Transl. into ENGLISH from West German Preliminary Patent Specification 25-08-803, 9 Sep. 1976 10 p Transl. by Sci. Transl. Serv., Santa Barbara, Calif. Original doc. prep. by Wacker-Chemitronic Ges. fuer Elektronik-Grundstoffe mbH, Burghausen (West Ger.)
(Contract NASw-2791)
(NASA-TM-75195) Avail: NTIS HC A02/MF A01 CSCL 20B

Plate shaped silicon crystals and their preparation by pouring a silicon melt into a suitable mold and then allowing it to solidify in a temperature gradient were investigated. The production of energy by direct conversion of solar energy into electrical energy by means of solar cells takes on increasing importance. While this type of energy production is already the prevailing form today in the realm of satellite technology, its terrestrial application has thus far encountered strict limitations owing to the high price of such solar cells. Of the greatest interest in this connection are silicon cells. A substantial reduction in the semiconductor material costs and the costs involved in the further processing to make solar cells are prerequisites for a rational market growth for solar energy. Author

N78-21958*# National Aeronautics and Space Administration, Washington, D. C.
THE SUPERCONDUCTIVITY OF CERTAIN TERNARY MOLYBDENUM COMPOUNDS
Roland Odermatt Apr. 1978 93 p refs Transl. into ENGLISH from thesis, Switzerland, Dec. 1973 106 p Transl. by Scientific Translation Service, Santa Barbara, Calif. Original doc. prep. by Geneva Univ. (Switzerland)
(NASA-TM-75250) Avail: NTIS HC A05/MF A01 CSCL 20L

The objectives of this work were to measure the superconductivity and critical fields of (Cu1.5Mo4.5), (SmMo5S6), and (Pb0.9Mo5.1S6) in order to reproduce the published results, and by introduction of magnetic impurities into these semiconductors, observe the compensation effect. Author

N78-21959# Stanford Univ., Calif. Edward L. Ginzton Lab.
PROPERTIES OF NEW SUPERCONDUCTING MATERIALS Final Research Report
Theodore H. Geballe Dec. 1976 24 p refs

(Grant AF-AFOSR-73-2435-73; AF Proj. 2306)
(AD-A050296; AFOSR-78-0112TR; GL-2760) Avail: NTIS HC A02/MF A01 CSCL 20/3

A large number of new and unusual superconductors have been discovered and their superconducting response to changes effected chemically, crystallographically, and physically has been studied. In this way, the interactions giving rise to superconductivity were examined. The effort has been concentrated in two major areas. First, the two-dimensionality of layered transition metal dichalcogenides, has allowed for a closer comparison between theory and experiment. Second, studying the instabilities of the high transition temperature phases has led to a greater understanding of the role of crystal structure and stoichiometry. For example, a new method of stabilizing films of Nb3Ge with superconducting transitions above 22k enabled the homogeneous stoichiometric composition to be reached by epitaxial growth on polycrystalline substrates. Thus, new approaches have been uncovered for synthesizing compounds with even higher superconducting transition temperatures. Author (GRA)

N78-21960# Polytechnic Inst. of New York, Brooklyn. Dept. of Physics.
IMPROVED CALCULATIONS OF X-RAY AND INELASTIC ELECTRON SCATTERING COMPTON PROFILES Semiannual Progress Report
Lawrence B. Mendelsohn Dec. 1977 24 p refs
(Contract N00014-75-C-0475)
(AD-A049513; Rept-77-3) Avail: NTIS HC A02/MF A01 CSCL 20/8

The Compton Defect Problem has been studied in several different approximations. Within the EH approximation, we have obtained an analytic expression for the 'local maximum' Compton defect at high momentum transfers. This analytic result gives good agreement with the electron scattering helium data at large angles, and reasonable agreement with the lithium and beryllium Compton defects determined from X-ray measurements. We have also performed very careful EHS defect calculations in helium by determining the center of gravity of the Compton profile in the same manner as the experiment. GRA

N78-21961# David Sarnoff Research Center, Princeton, N.J.
EPITAXIAL GROWTH OF SEMI-INSULATING GaAs Semiannual Report, 1 Jul. - 31 Dec. 1977
S. T. Jolly and D. Yaney Dec. 1977 13 p refs
(Contract N00014-77-C-0542; ARPA Order 3441)
(AD-A050030) Avail: NTIS HC A02/MF A01 CSCL 20/12

The objective of this program is to develop techniques for the vapor phase growth of high resistivity epitaxial layers of gallium arsenide on semi-insulating gallium arsenide substrates. A capability to grow such layers of high quality material with minimum structural defects and good surface quality for use as 'buffer' layers prior to the growth of active layers for such devices as FETS and TELDS will eliminate the device performance problems caused by poor and inconsistent substrate quality. Author (GRA)

N78-21962# Northwestern Technological Inst., Evanston, Ill.
AN APPLIED OVERVIEW OF MOVING BOUNDARY PROBLEMS
Bruno A. Boley Aug. 1977 29 p refs Presented at the Symp. and Workshop on Moving Boundary Probl., Gatlinburg, Tenn., 26-28 Sep. 1977
(Contract N00014-75-C-1042)
(AD-A049695; TR-1977-2) Avail: NTIS HC A03/MF A01 CSCL 20/12

An overview of moving-boundary problems is sketched in a general way with emphasis on some types of problems in which further work appears to be desirable from an applied viewpoint. Areas touched are those of the mechanical behavior of melting or solidifying bodies, the establishment of suitable constitutive equation, the use of approximate methods, the state of multidimensional problems, and the application of continuum approaches to the study of crystal growth. Author (GRA)

N78-21963# California Univ., Berkeley. Dept. of Physics.
PERFORMANCE LIMITS OF A JOSEPHSON JUNCTION MIXER Technical Report, 1 Feb. 1977 - 31 Jan. 1978
John H. Claassen (NRL, Washington, D. C.) and Paul L. Richards Sep. 1977 56 p refs
(Contract N00014-75-C-0496)
(AD-A049544) Avail: NTIS HC A04/MF A01 CSCL 09/5

The results of extensive analog computer simulations of a Josephson junction used as a mixer with an external local oscillator are presented. The Resistively Shunted Junction model was used throughout, and the effects of intrinsic junction noise were included. When the source impedance is much greater than the junction resistance R our simulations permit predictions of conversion efficiency, noise temperature, and saturation level to be made for a wide range of experimental parameters. The possibility of harmonic mixing has also been considered. With a source resistance comparable to R (i.e., conventional matching) the behavior of the system is too complicated to permit such general predictions of performance. From the results of simulations for a particular set of parameters it appears that the best noise temperature will usually be achieved for a source impedance somewhat greater than R. An upper limit for the mixer noise temperature is approximately 40 T over a broad range of junction parameters, where T is the effective temperature of the junction. The Conversion efficiency under these circumstances should be comparable to what is potentially available from Schottky diode mixers. Our simulations show that with stronger microwave coupling it is possible to obtain conversion gain i.e., a conversion efficiency exceeding unity. This, however, will probably be at the expense of a higher mixer noise temperature. GRA

N78-21964# California Univ., San Diego, La Jolla. Dept. of Physics.
BINDING ENERGY AND EFFECTIVENESS MASS OF CHARGED PARTICLES TRAPPED ON SURFACES Final Report, 31 Oct. 1976 - 1 Nov. 1977
Oscar Hipolito and W. Kohn Nov. 1977 17 p refs
(Contract N00014-76-C-0050)
(AD-A049945; TR-44) Avail: NTIS HC A02/MF A01 CSCL 07/4

The interaction of a charged particle with the surface excitations of a semi-infinite medium was explored. Only where the particle is outside the material and trapped near the surface by its image potential was considered. By the use of canonical transformation which exhibits the bound states due to the image charge in the nonperturbed transformed Hamiltonian, the binding energy and the effective mass of a charged particle were determined for motion parallel to the surface. For the highest perpendicular sub-bands the correction to the energy and mass of the particle are negligible. Applying the method to determine the binding energy of ground state of an electron trapped near the LiF surface, one finds the value E(0) = -0.25 eV. Author

N78-21965# Rockwell International Corp., Anaheim, Calif. Electronic Devices Dept.
THIN FILMS OF GALLIUM ARSENIDE ON LOW-COST SUBSTRATES Quarterly Report, 2 Jan. - 2 Apr. 1977
R. P. Ruth, P. D. Dapkus, R. D. Dupuis, A. G. Campbell, R. E. Johnson, H. M. Manasevit, L. A. Moudy, and R. D. Yingling Apr. 1977 59 p refs
(Contract EY-76-S-03-1202)
(SAN/1202-77/2; QR-3) Avail: NTIS HC A04/MF A01

The metallorganic chemical vapor deposition (MO-CVD) technique was applied to the growth of thin films of GaAs and GaAlAs on inexpensive polycrystalline or amorphous substrate materials (glasses, glass-ceramics, aluminum ceramics, and metals) for use in fabrication of large area low cost photovoltaic device structures. Polycrystalline GaAs films have now been grown on all of the low cost materials on the candidate substrate list. Single crystal films of GaAs and Ga/sub 1-x/Al/sub x/As(x approximately 0.8) were grown to study the Zn and Se doping of these materials and to provide the doping data needed to grow p-n junctions and heterostructure solar cell configurations. The physical properties of GaAs films grown on a variety of substrates-including Mo/glass, Mo/aluminum, and Ge layers on all of the candidate insulator materials were studied, and the results of these investigations are described. ERA

N78-21966# Oak Ridge National Lab., Tenn.
ANALYSIS OF ANGULAR DEPENDENT AUGER SPECTROSCOPY (ADAS) BASED ON A QUASIATOMIC MODEL
H. L. Davis 1977 4 p refs Presented at 7th Intern. Vac.

Congress and 3d Intern. Conf. on Solid Surfaces, Vienna, Austria, 12 Sep. 1977
(Contract W-7405-eng-26)
(CONF-770908-6) Avail: NTIS HC A02/MF A01

Calculated results are presented which are in good agreement with published M2,3VV Cu(100) ADAS data. The calculations are based on a quasiatomic model where each individual Auger emission is a partial wave of definite (l,m) character, but (l,m) may differ from emission to emission. The (l,m) emission weights were estimated by fitting the data with a linear combination of calculated intensities for (l,m) up to 1 = 5. It is found that surprisingly few (l,m) values are necessary to obtain reasonable fits to the data, and the best fits occur for combinations of (l,m) intensities in which the 1 = 3 waves were most heavily weighted. ERA

N78-21967# Oak Ridge National Lab., Tenn. Fusion Energy Div.
EFFECT OF FLUX FLOW ON SELF-FIELD INSTABILITY
Lawrence Dresner Apr. 1977 29 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5986) Avail: NTIS HC A03/MF A01

Flux flow caused type 2 superconductors to develop resistance continuously rather than suddenly as transport current increased. The distribution of current among the filaments in a composite was determined not only by their inductive coupling but also by the longitudinal resistance they developed as they began to carry current. The current distribution was calculated in two cases, taking flux flow into account: a composite clamped suddenly across a constant current source and composite charged with current at a uniform rate. The results of the latter problem were used to show that slowly charged conductors were much more stable against self field instability than was indicated by purely inductive calculations. ERA

N78-21968# Sandia Labs., Albuquerque, N. Mex.
HIGH-PRESSURE STUDIES OF SOFT MODE TRANSITIONS IN SOLIDS
G. A. Samara 1977 33 p refs Presented at Intern. Conf. on High Pressure and Low Temp. Phys., Cleveland, 20 Jul. 1977
(Contract EY-76-C-04-0789)
(SAND-77-1188C; Conf-770722-2) Avail: NTIS HC A03/MF A01

An overview of the soft mode concept and of high pressure studies of soft mode transitions in solids is given. Typical results on displacive ferroelectric (SbSI) antiferrodistortive [Gd2(MoO4)3 and BaMnF4] transitions as well as on coupled proton-phonon soft mode transitions (KH2PO4) are used to demonstrate that hydrostatic pressure can strongly modify the balance of forces responsible for soft mode behavior. Emphasis is placed on the physical implications of mode behavior. Emphasis is placed on the physical implications of the results and on the general trends of the available data on the different classes of soft mode transitions, for it is such trends that have led to a greater understanding of the nature of the forces involved. ERA

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

No abstracts in this category.

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N78-21969 Oklahoma State Univ., Stillwater.
THE MEASUREMENT OF COOPERATION AND THE DETERMINATION OF CAUSAL VARIABLES FOR COOPERATION IN A TECHNICAL ENVIRONMENT Ph.D. Thesis
Larry Orville Daniel 1977 132 p
Avail: Univ. Microfilms Order No. 78-01231

A model that measures technical cooperation in a government engineering environment and determines the strategic variables that affect it is developed. Policy capturing, factor analysis, and multiple regression techniques are the basic tools of the model. Twenty government engineering supervisors and 174 government engineers took part in the study. One hundred and two of the engineers served as the population sample and 72 participated in research instrument validation concerning cooperation causal factors. Cooperation was measured by having the 20 engineering supervisors rate 30 simulated work units for cooperation. Using the results of the simulated units, the cooperation of the population sample was determined and cooperation causal factors were regressed on this measure to determine the strategic variables. Dissert. Abstr.

N78-21970*# Ross (S.) and Co., Boston, Mass.
CONTINUED IMPLEMENTATION AND TESTING OF A NEIGHBORHOOD OFFICE CENTER (NOC) AND INTEGRATION OF THE NOC WITH AN ADMINISTRATIVE CORRESPONDENCE MANAGEMENT INFORMATION SYSTEM Final Report
16 Mar. 1978 85 p
(Contract NASw-3057)
(NASA-CR-156150) Avail: NTIS HC A05/MF A01 CSCL 05A

The concept of decentralized (remote) neighborhood offices, linked together through a self-sustaining communications network for exchanging voice messages, video images, and digital data was quantitatively evaluated. Hardware and procedures for the integrated multifunctional system were developed. The configuration of the neighborhood office center (NOC) is explained, its production statistics given, and an experiment for NOC network integration via satellite is described. The hardware selected for the integration NOC/management information system is discussed, and the NASA teleconferencing network is evaluated. A.R.H.

N78-21971# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
GROUP REPLACEMENT OF A MULTICOMPONENT SYSTEM WHICH IS SUBJECT TO DETERIORATION ONLY
B. D. Sivazlian and J. F. Mahoney Oct. 1977 37 p refs
(Grants DAHC04-75-G-0150; AF-AFOSR-2605-76)
(AD-A049502; RR-77-14; ARO-12640.20M) Avail: NTIS HC A03/MF A01 CSCL 15/5

The stationary characteristics of an n-component periodic review system which is subject to stochastic deterioration (but not to failure) are investigated. When the n-component vector which expresses the state of deterioration of the system pierces a certain surface the entire multicomponent system is replaced by items of identical cost structure at the time of the next review. In the absence of this situation nothing is replaced. It is assumed that there is a fixed cost associated with each replacement and that the operating cost of each item is a strictly increasing function of its state of deterioration. The conditions for minimizing the long-term cost of maintaining a system which

operates under the stated policy were found through solution of a problem in variational calculus. Two examples are worked. A useful graph which aids in the solution of such problems is provided. Author (GRA)

N78-21972# Joint Conventional Ammunition Program Coordinating Group, Rock Island, Ill. Decision Models Directorate.

PERFORMANCE PREDICTORS FOR VALUE ENGINEERING PROGRAM MANAGEMENT Final Report

Daniel R. Turk Sep. 1977 40 p refs

(AD-A049696; JCAP-DM-T705) Avail: NTIS HC A03/MF A01 CSCL 14/1

This report presents the results of a study conducted by the Decision Models Directorate of the Joint Conventional Ammunition Program (JCAP-DM) during the 3d quarter FY77 for the purpose of developing predictive equations for management use in establishing annual quantitative performance goals for the Value Engineering (VE) Program of the US Army Armament Materiel Readiness Command (ARRCOM). The predictive equations that were developed cover the three primary performance factors upon which the program is evaluated: (1) Dollar savings resulting from approved VE proposals. (2) Number of VE proposals submitted by contractors, and (3) Number of VE proposals submitted by in-house organizations. The report presents the study objectives, the methodology, the computation techniques using interactive programs, and the results. Input data and program output are provided. The method, which employs a combination of time-series analyses and step-wise regression techniques, indicated high correlation for this application. The forecast PEMA appropriation was always a dominant variable in predicting VE program performance. The method is applicable in situations where historical data is available and prediction equations are desired. Author (GRA)

N78-21973# Houston Univ., Tex.

MORPHOLOGY OF DESIGN OF AEROSPACE SYSTEMS WITH INCLUSION OF HUMAN FACTORS Final Scientific Report, 1 Oct. 1976 - 31 Aug. 1977

Benjamin Ostrofsky Aug. 1977 149 p refs

(Grant AF-AFOSR-3148-77)

(AD-A049999; AFOSR-78-0066TR) Avail: NTIS HC A07/MF A01 CSCL 05/1

This research report is intended to provide a basic clarification of the decision structure and methodology for the design of a high technology, large scale system with emphasis on integration of human factors and their associated metrics. The report summarizes and relates the design morphology to current USAF methodology for the management of system design, defines and classifies human factors which influence the decision structure of design, and clarifies the nature of subjective and objective requirements which are inputs to the decision structure. The conceptual framework developed as an effective approach to the solution of the problem of human factors inclusion into the design morphology is that of a three dimensional matrix representing the relationship among human factors, the design steps, and the current literature. This relationship allows for explicit human factors inclusion during the preliminary design phase of a new system and the resultant inclusion in the criteria function for the optimal design configuration. Author (GRA)

N78-21974# Analytics, Inc., Willow Grove, Pa.

OPERATIONAL DECISION AIDS: THE APPLICATION OF NOMOGRAPHY AND UNCERTAINTY ANALYSIS TO DECISION-AIDING SYSTEMS Technical Report, 15 Sep. 1976 - 14 Sep. 1977

S. Epstein, M. Strieb, R. Goldman, F. Glenn, and R. Wherry 15 Nov. 1977 149 p refs

(Contract N00014-76-C-1116)

(AD-A049545; TR-1218-A) Avail: NTIS HC A07/MF A01 CSCL 05/10

This report describes analyses performed and conclusions obtained in applying nomography and uncertainty analyses to decision aiding systems. The models described here have been implemented for test and evaluation in the University of Pennsylvania ODA test facility. Nomography is the art or science of constructing graphs that enable a dependent variable to be determined by the use of ortholinear projections given the values of one or more independent variables. Uncertainty is any imprecision in knowledge resulting from causes such as inaccuracy, lack of validity, or bias in the inputs to a decision. The analysis focuses on the specific decision problem of air strike delay in the context of the ONRODA strike warfare scenario. The baseline approach from which study embarked is reported in Decision Analysis as an Element in an Operational Decision Aiding System (DDI Technical Report 75-13 for ONR, AD-A018 109). While developed in a specific framework, the conclusions, methodology, and models are applicable to the broad class of decision problems which require selection of the best time to initiate a specified action. With modification, the approach can be applied to the multiple-choice decision problem. GRA

N78-21975# CACI, Inc., Arlington, Va.

EXECUTIVE AIDS FOR CRISIS MANAGEMENT Final Technical Report, 1 Dec. 1976 - 31 Aug. 1977

Leo A. Hazelwood, Janice Fain, Farid Abolfachi, John Hayes, John McIlroy, and Paul Davis 31 Aug. 1977 82 p refs

(Contract N00014-77-C-0135; ARPA Order 2928)

(AD-A049954; CAC361B) Avail: NTIS HC A05/MF A01 CSCL 05/1

This final technical report documents research on developing a prototype executive aid for crisis management. The report contains four chapters, four appendices, and a bibliography. Chapter 1 describes the effort in the context of ARPA's Crisis Management Program. Chapter 2 reviews the structure of the prototype executive aid, while Chapter 3 considers the role of data in the aid and the types of data required. Chapter 4 summarizes aid evaluation and transfer. The four appendices highlight various facets of the research, including the sample for which data have been collected, the types of data gathered, and the weighted objectives solution algorithm. Author (GRA)

N78-21976# General Accounting Office, Washington, D. C. Health Resources Div.

SUMMARIES OF CONCLUSIONS AND RECOMMENDATIONS ON THE OPERATIONS OF CIVIL DEPARTMENTS AND AGENCIES

26 Jan. 1978 400 p

(PB-276094/0; HRD-78-23) Avail: NTIS HC A17/MF A01 CSCL 05A

A follow-up report is given on a recommendation of the House Government Operations Committee and the Commission on Government Procurement that a continuing program of research be used to create better procurement practices and to design and test the best ways to carry out new policies. GRA

N78-21977# General Accounting Office, Washington, D. C. Logistics and Communications Div.

ECONOMIES AVAILABLE THROUGH IMPROVED INVENTORY MANAGEMENT

18 Jan. 1978 26 p

(PB-276048/6; LCD-78-212) Avail: NTIS HC A03/MF A01 CSCL 05A

Methods are given showing how General Service Administration can save millions of dollars annually through improved procedures and practices for procuring, managing, and supplying inventories. GRA

N78-21978# General Accounting Office, Washington, D. C. Procurement and Systems Acquisition Div.

FEDERAL AGENCIES SHOULD BE GIVEN MULTIYEAR CONTRACTING AUTHORITY FOR SUPPLIES AND SERVICES

10 Jan. 1978 33 p

(PB-276028/8; PSAD-78-54) Avail: NTIS HC A03/MF A01 CSCL 05A

Most Federal agencies operating with annual appropriations are prohibited from contracting for more than 1 year. The Commission on Government Procurement recommended that legislation be enacted to permit multiyear contracting by all agencies when judgement dictates that the Government will benefit. Legislation is now under consideration to accomplish this. GAO reassessed the advantages and disadvantages of multiyear procurement and found that it would be an advantageous procurement method. GAO recommends that the Congress enact legislation authorizing general multiyear contracting authority of Federal agencies and provide for the Office of Federal Procurement

Policy to develop appropriate criteria to guide Federal agencies in its use. GRA

N78-21979# General Accounting Office, Washington, D. C. Procurement and Systems Acquisition Div.
A RANGE OF COST MEASURING RISK AND UNCERTAINTY IN MAJOR PROGRAMS: AN AID TO DECISION MAKING
2 Feb. 1978 33 p
(PB-276384/5; PSAD-78-12) Avail: NTIS HC A03/MF A01 CSCL 05A

In deciding whether to approve or fund a major program or weapon system, federal agencies and the Congress must assess: (1) need; (2) the most cost beneficial of several alternatives; and (3) what tradeoffs affecting other programs are necessary considering overall national priorities. Such assessments depend on expected program cost to a far greater extent than in the past. The single-point or specific-dollar estimate now used assumes a certainty as to cost that does not exist. The Government Accounting Office proposes the use of a range of cost, in addition to the point estimate. Presenting a range of cost should help decisionmakers assess the potential cost impact on the program if these uncertainties occur. GRA

N78-21980# National Academy of Sciences - National Research Council, Washington, D. C. Ocean Sciences Board.
THE QUALITY OF NOAA'S OCEAN RESEARCH AND DEVELOPMENT PROGRAM: AN EVALUATION
1977 149 p
(PB-277095/6; NOAA-78020801) Avail: NTIS HC A07/MF A01 CSCL 05A

The quality, vitality, and health of the ocean research and development conducted by the National Oceanic and Atmospheric Administration (NOAA) in comparison with others in the ocean science community is discussed. The ocean R&D carried out within all the major line components is intended in part to meet statutory responsibilities which cover a broad range, including fisheries, ocean dumping and marine protection, disasters and the environment, some marine mammals, coastal zone management, mapping and charting, energy, and ocean technology. Individual reports on each component summarize their strengths and weaknesses. Recommendations for improvement are delineated. GRA

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N78-21981# Naval Ship Research and Development Center, Bethesda, Md.
NOTES ON DATA FILE EXCHANGE BETWEEN THE NRL TIASC AND THE DTNSRDC CDC-6616700
Paul E. Morawski Dec. 1977 15 p
(AD-A049797; DTNSRDC-TM-184-78-02) Avail: NTIS HC A02/MF A01 CSCL 09/2

The capability exists to exchange EBCDIC coded 9-track tape files between the Texas Instruments Advanced Scientific Computer (TIASC) located at the Naval Research Laboratory and the TIASC Remote Job Entry Terminal located at DTNSRDC. This provides an indirect method to transfer data files between the TIASC and the DTNSRDC CDC-66/6700 computers. Such file exchange allows users in Code 1843 to display results of fluid dynamics calculations performed on the TIASC using interactive computer graphics software available on the DTNSRDC CDC-66/6700. FORTRAN and RATFOR programs may also be transferred. This memorandum is to familiarize users with the tape copy procedure and to document the two programs which are available to process card-image files to be transferred. GRA

N78-21982# Stanford Univ., Calif. Electronics Labs.
[DEVELOPMENT AND APPLICATION OF DATA PROCESSING AND PATTERN RECOGNITION METHODS] Semiannual Status Report, 1 Jan. - 30 Jun. 1977
30 Jun. 1977 109 p refs
(Contract N00014-75-C-0601)
(AD-A049846; SU-SEL-77-037; SASR-132) Avail: NTIS HC A09/MF A01 CSCL 09/2

The status of a number of ongoing research projects is reviewed. Some of the projects are: data processing and pattern recognition; automatic control systems design; imaging of gamma ray distributions; and statistical system theory. In addition, abstracts of published reports are given. P.R.A.

N78-21983# Naval Research Lab., Washington, D. C.
AXIOMATIC CHARACTERIZATION OF A FAMILY OF INFORMATION MEASURES THAT CONTAINS THE DIRECTED DIVERGENCES Interim Report
Rodney W. Johnson Nov. 1977 29 p refs
(AD-A050096; AD-E000078; NRL-MR-3646) Avail: NTIS HC A03/MF A01 CSCL 09/4

Let p and q be probability densities. The directed divergences of p and q are given by the integral $p(x) \log (p(x)/q(x))dx$ and by the same expression with p and q interchanged; the divergence is the sum of the directed divergences. These quantities have applications in information theory and to the problem of assigning prior probabilities subject to constraints. In this report, it is shown that the directed divergences and their positive linear combinations, including the divergence, are characterized by axioms of positivity, additivity, and finiteness; in the course of the proof, the latter two are shown to imply yet another axiom; invariance. These axioms are fundamental in work on prior probabilities. It has been claimed that they characterize only constant multiples of the single directed divergence; that claim is here refuted. GRA

N78-21984# Army Aviation Research and Development Command, St. Louis, Mo.
A COMPUTERIZED LOG FOR SYSTEMS AND COST ANALYSIS DIVISION COST ESTIMATE CONTROL DATA CENTER (CECDC) VALIDATION ACTIVITY Final Report
Joanne A. Ragan Jan. 1978 23 p
(AD-A049976; USAAVRADCOM-TR-78-1) Avail: NTIS HC A02/MF A01 CSCL 05/2

Responsibility for validating and/or reviewing documents containing cost estimates has been assigned to the CECDC function of DRDAV-BC. In order to utilize the speed and accuracy available with automatic data processing, a computer program has been developed to process the appropriate information from these documents, to aid in preparation of the necessary reports and to provide a historical log of the documents which have been processed. The logging procedure includes portions accomplished manually as well as the portion produced by the computer. After a document has been validated (or rejected) by a CECDC analyst, specific information is logged before the document is returned to the proponent. Periodically, these records are key punched onto IBM punch cards, which are then processed by the IBM 360/65 computer using the specially designed Computerized Log Program. Within the computer, data records are sorted by aircraft system, and are then printed out in group arrangement according to type of validation, aircraft type, and month. GRA

N78-21985# Drexel Univ., Philadelphia, Pa.
INCENTIVES FOR THE GENERATION, DISSEMINATION AND USE OF SCIENTIFIC AND TECHNICAL INFORMATION
Rodger D. Collons, Donald W. Jarrell, and Alok K. Chakrabarti Sep. 1977 24 p refs Conf. held at Philadelphia, 10-11 Mar. 1977
(Grant NSF DSI-76-19623)
(PB-276180/7) Avail: NTIS HC A02/MF A01 CSCL 05B

The objective was to identify a set of policy and procedural incentives which will be potentially fruitful for improving the generation, dissemination and use of scientific and technical information. This objective was accomplished by holding a day and a half conference in which key decision makers and specialists in scientific and technical information systems were brought together with incentive area experts (from law, economics, sociology, and psychology) to address the issue of incentives

for the generation, dissemination, and use of scientific and technical information. GRA

N78-21986# California Univ., Livermore. Lawrence Livermore Lab.
DECISION MAKING WITH INTERACTIVE ACCESS TO INTEGRATED ADMINISTRATIVE AND TECHNOLOGICAL DATA BASES. AN ILLUSTRATED CONCEPTUAL OVERVIEW
Viktor E. Hampel 14 Sep. 1977 64 p refs Presented at ERDA/AESOP 17th Conf., Boston, 13-15 Sep. 1977 Submitted for publication
(Contract W-7405-eng-48)
(UCRL-80353; Conf-770937-3) Avail: NTIS HC A04/MF A01

A computer based Integrated Information System intended to support the ongoing research and development work in the energy storage area of energy research and to permit comparative decision making by computer and cost/risk/benefit analyses is described. Bibliographic and numeric reference materials on batteries employing aqueous and high temperature electrolytes, molten salt energy storage, alloys and fiber composites of flywheels, and for hydrogen-based energy storage compounds, and evaluation criteria on the performance of energy storage systems are compiled in the data base and are accessible interactively from remote terminals. Features of the system include accessibility over computer networks and by dial-up over telephone lines and conferencing and electronic mail delivery with a VOTRAX voice synthesizer. ERA

N78-21987# National Commission on New Technological Uses of Copyrighted Works, Washington, D. C.
TRANSCRIPT OF NATIONAL COMMISSION ON NEW TECHNOLOGICAL USES OF COPYRIGHTED WORKS
Oct. 1977 298 p ref Seventeenth meeting held at Washington, D. C., Oct. 21, 1977
(PB-275786/2; CONTU-77-0013) Avail: NTIS HC A13/MF A01 CSCL 05B

Testimony is presented concerning the copyright law and it's effect on library photocopying practices. Development of workable clearances and licensing procedures is stressed. J.M.S.

N78-21988# National Federation of Abstracting and Indexing Services, Philadelphia, Pa.
CONFERENCE REPORT TO THE NATIONAL SCIENCE FOUNDATION ON THE NFAIS/ASIDIC/EUSIDIC/ICSUAB MEETING ON BIBLIOGRAPHIC CONTROL Final Report
Toni Carbo Bearman 22 Jul. 1977 31 p Meeting held at Creaton, England, 26-29 Jun. 1977
(Grant NSF DSI-77-17202)
(PB-275791/2; NFAIS-77/3) Avail: NTIS HC A03/MF A01 CSCL 05B

Data content and format of computer-readable bibliographic data bases are considered. A minimum set of data elements and their content descriptions for searching and for document identification for journal articles are developed. Recommendations on individual data elements are to be submitted to UNIBID for consideration in revision of the UNISIST Reference Manual.GRA

N78-21989# Patent and Trademark Office, Washington, D. C. Office of Technology Assessment and Forecast.
TECHNOLOGY ASSESSMENT AND FORECAST REPORT, 8 Semiannual Report
Dec. 1977 143 p ref Sponsored by Dept. of Commerce
(PB-276375/3) Avail: NTIS HC A07/MF A01 CSCL 05B

The geophysical exploration for hydrocarbons is examined, with an analysis of this technology as a whole, and areas of geophysical exploration techniques; an analysis of patents as a unique technological resource, considering patents as a resource of technological information which, apart from patent prosecution, is seldom tapped by the scientific community. GRA

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N78-21990# Cornell Univ., Ithaca, N. Y. Dept. of Agricultural Economics.
SIMULATION MODEL FOR RESOURCE POLICY EVALUATION
W. E. Tyner and R. J. Kalter Sep. 1977 52 p refs Revised
(Grant NSF SIA-74-21846)
(PB-275938/9; STAFF-Paper-77-28; NSF/RA-770323) Avail: NTIS HC A04/MF A01 CSCL 05C

A model which can be used to evaluate certain policy questions pertaining to various resources located on the public domain is described. The generalized leasing model (GEN2), which incorporates many factors important for public policy decisions into a framework of private market behavior, is designed to determine the impacts of many alternative federal policies aimed at reducing risk for private resource development. A wide range of leasing policy alternatives is also incorporated into the model so that it may be used to analyze the effects of alternate leasing strategies. The generalized model can be applied to any resources. GRA

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N78-21991*# National Aeronautics and Space Administration, Washington, D. C.
APPLICATIONS NOTICE
19 Apr. 1978 43 p
(AN-OSTA-78-A) Avail: NTIS HC A03/MF A01 CSCL 05A

The discipline programs of the Space and Terrestrial (S&T) Applications Program are described and examples of research areas of current interest are given. Application of space techniques to improve conditions on earth are summarized. Discipline programs discussed include: resource observations; environmental observations; communications; materials processing in space; and applications systems/information systems. Format information on submission of unsolicited proposals for research related to the S&T Applications Program are given. J.M.S.

N78-21992# ACT Systems, Inc., Winter Park, Fla.
THE COST OF WATER SUPPLY AND WATER UTILITY MANAGEMENT, VOLUME 1 Socioeconomic Environmental Studies Series
Robert M. Clark (Municipal Environ. Res. Lab., Cincinnati), James I. Gillean, and W. Kyle Adams Nov. 1977 181 p refs
(Contract EPA-68-03-2071)
(PB-276639/2; EPA-600/5-77-015a-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 13B

Twelve selected water utilities were studied to determine the economics of water delivery. Data were collected from at least one Class A water utility (revenues greater than $500,000/

year) in each of the U.S. Environmental Protection Agency's 10 regions. Summary information and in-depth analysis of the 12 utilities studied are presented. All the utilities are analyzed in aggregate, and factors affecting the cost of water supply are examined. The hypothetical impact in 1980 of a proposed organic regulation, promulgated under the Safe Drinking Water Act is evaluated. GRA

N78-21993# ACT Systems, Inc., Winter Park, Fla.
THE COST OF WATER SUPPLY AND WATER UTILITY MANAGEMENT, VOLUME 2 Socioeconomic Environmental Studies Series
James I. Gillean, W. Kyle Adams, and Robert M. Clark (Municipal Environ. Res. Lab., Cincinnati) Nov. 1977 310 p
(Contract EPA-68-03-2071)
(PB-276640; EPA-600/5-77-015b-Vol-2) Avail: NTIS HC A14/MF A01 CSCL 13B

The basic data obtained during studies of 12 water utilities are presented. Services of each utility were divided into five functional areas common to all water supply delivery systems - support services, acquisition, treatment or purification, distribution and power and pumping. These categories provided a common basis for collecting and comparing data. Costs were categorized as operating or capital expenditures. GRA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N78-21994 California Univ., Berkeley.
SPECTROPHOTOMETRIC INVESTIGATIONS OF WHITE DWARF STARS Ph.D. Thesis
James William Liebert 1977 193 p
Avail: Univ. Microfilms Order No. 77-31438

Analyses of a variety of individual white dwarf stars, inspired by image tube spectrophotometry are presented. The results divide into four groups: (1) The Hottest White Dwarfs. Scans are presented of HZ43 and Feige 24, the first detected non-solar EUV sources. Stellar parameters are derived, as are spectroscopic parallaxes for each red dwarf companion. (2) Cool Degenerate Stars. Scans of very cool DA and nonDA stars are presented. (3) Low Luminosity Carbon Stars. Observations of several established C2-band white dwarfs are discussed. New C I and C2 features are identified, but no non-carbon features are definitely found. (4) Magnetic White Dwarfs. A new magnetic star, Feige 7, has been found to have a rich optical spectrum with Zeeman components of both hydrogen and neutral helium; it is also a circular polarization and spectrum variable with a period of 2.2 hours. Dissert. Abstr.

N78-21995 California Univ., Berkeley.
TWO THEORETICAL PROBLEMS IN CLOSE BINARY STARS Ph.D. Thesis
Stephen Harvey Lubow 1977 146 p
Avail: Univ. Microfilms Order No. 77-31447

There are two major classes of close binaries, the semidetached and the contact systems. A problem is investigated for each type. In the semidetached case the mass-transfer is analyzed in some detail. The gas dynamical problem is solved using a perturbation technique. The other problem is concerned with the interior structure of contact systems. The difficulties encountered in constructing interior models can be solved by allowing a contact discontinuity at the Roche lobe of the small component. This discontinuity is maintained against thermal diffusion by fluid flow. The results for two models, one having a common convective envelope and the other having a common radiative envelope are described. These models are plotted on a period-color diagram and comparisons are made with observed W UMa systems. Dissert. Abstr.

N78-21996 California Inst. of Tech., Pasadena.
FAR INFRARED OBSERVATIONS OF THE GALACTIC CENTER Ph.D. Thesis
Ian Gatley 1977 83 p
Avail: Univ. Microfilms Order No. 78-01530

Maps of a region minutes in diameter around the galactic center made simultaneously in three wavelength bands at 30 microns, 50 microns, and 100 microns with approximately 1 minute resolution are presented, and the distribution of far infrared luminosity and color temperature across this region is derived. The position of highest far infrared surface brightness coincides with the peak of the late type stellar distribution and with the H II region Sgr A West. The high spatial and temperature resolution of the data was used to identify features of the far infrared maps with known sources of near infrared, radio continuum, and molecular emission. The emission mechanism and energy sources for the far infrared radiation were analyzed qualitatively, and it was concluded that all of the observed far infrared radiation from the galactic center region was attributed to thermal emission from dust heated both by the late type stars and by the ultraviolet sources which ionize the H II regions. Dissert. Abstr.

N78-21997 Columbia Univ., New York.
A SURVEY OF CARBON MONOXIDE IN CYGNUS X Ph.D. Thesis
Hong-ih Louis Cong 1977 168 p
Avail: Univ. Microfilms Order No. 78-02320

An area approximately bounded by alpha (1950) = 20h-10m - 20h55m, and delta (1950) = 36 deg - 45 deg in the region of Cygnus X, has been mapped in C-12 0-16 with the Columbia four foot telescope. Seventy-eight molecular sources have been found and appear to correlate well with various objects in Cygnus X, such as radio continuum sources, emission nebulae, compact sources, reflection nebulae and dark clouds. There are three major molecular cloud complexes in Cygnus X, each of which is associated with a group of H II regions and compact sources of OH, H2O masers. Distances to the molecular clouds range from 200 to 2700 pc, with the above three cloud complexes at distances between approximately 1000 and 2000 pc. C-13 0-16 was also observed at approximately twenty molecular sources, and extensively mapped in the direction of W75. Ratios of C-12 0-16 to C-13 0-16 antenna temperatures are generally a factor of 2 to 3, and the excitation temperatures in molecular sources range from 6 to 29 K. Total mass of all the molecular sources in Cygnus X is estimated at 1,000,000 M sub circled dot. Dissert. Abstr.

N78-21998 Minnesota Univ., Minneapolis.
LABORATORY SIMULATION OF INFRARED ASTROPHYSICAL FEATURES Ph.D. Thesis
Louis Allen Rose 1977 150 p
Avail: Univ. Microfilms Order No. 78-02710

Laboratory infrared emission and absorption spectra were taken of terrestrial silicates, meteorites and lunar soils in the form of micrometer and sub-micrometer grains to determine which materials best simulate the 10 micron m astrophysical feature. The emission spectra of forsterite, fayalite and Allende give a good fit to the 10 micron broadband emission feature of Comets Bennett and Kohoutek. Three mixtures of silicates which would yield spectra that match the spectrum of Comet Kohoutek in the 10 micron region are: (1) a hydrous layer lattice silicate in combination with a high temperature condensate such as olivine or anorthite to broaden the feature; (2) an amorphous magnesium silicate in combination with a high temperature condensate, and (3) glassy olivine and glassy anorthite in approximately equal proportions. Dissert. Abstr.

N78-21999*# Sacramento Peak Observatory, Sunspot, N. Mex.
PRELIMINARY DESIGN ANALYSIS FOR THE SOLAR OPTICAL TELESCOPE MAIN MIRROR ACTUATOR
Richard B. Dunn Aug. 1977 44 p Sponsored in part by NSF (NASA Order S-54177A)

(NASA-CR-156701) Avail: NTIS HC A03/MF A01 CSCL 03A

The resolution of the SOT Gregorian telescope was maintained if the conic foci of the elliptical secondary and parabolic primary were made to coincide within plus or minus 38 microns across the prime focus plane and to within 5 microns in focus. An error in coincidence across the focal plane caused all point images to show additional coma with all the comatic tails pointing in the same direction. An error in focus became magnified by the square of the magnification of the secondary and simply increased the diameter of the point source. Offsetting or rastering the sun may be accomplished by swinging the primary in an arc about the point of coincidence of the conic foci so long as the coincidence is kept to within the tolerance stated. Author

N78-22000*# Santa Barbara Research Center, Goleta, Calif.
CONTINUED DEVELOPMENT OF DOPED-GERMANIUM PHOTOCONDUCTORS FOR ASTRONOMICAL OBSERVATIONS AT WAVELENGTHS FROM 30 TO 120 MICROMETERS Final Technical Report
P. R. Bratt, N. N. Lewis, and L. E. Long 24 Apr. 1978 61 p refs
(Contract NAS2-9599)
(NASA-CR-152125) Avail: NTIS HC A04/MF A01 CSCL 03A

The development of doped-germanium detectors which have optimized performance in the 30- to 120-mu m wavelength range and are capable of achieving the objectives of the infrared astronomical satellite (IRAS) space mission is discussed. Topics covered include the growth and evaluation of Ge:Ga and Ge:Be crystals, procedures for the fabrication and testing of detectors, irradiance calculations, detector responsivity, and resistance measurements through MOSFET. Test data are presented in graphs and charts. Author

N78-22001# Lincoln Lab., Mass. Inst. of Tech., Lexington.
REAL-TIME, INTERMEDIATE-FIELD ASTROMETRY
John M. Sorvari 28 Oct. 1977 23 p refs
(Contract F19628-78-C-002)
(AD-A048155; ETS-21; ESD-TR-77-276) Avail: NTIS HC A02/MF A01 CSCL 03/1

An experiment to test the accuracy of a very simple calibration scheme is described. It is concluded that a mean-offset, three-star calibration working from a catalog of 1600 reference stars can provide positional accuracy of ten seconds of arc with the ETS equipment. Author (GRA)

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N78-22002 Cornell Univ., New York.
CONSIDERATIONS ON DENSE MATTER IN ASTROPHYSICS Ph.D. Thesis
Richard Livingston Weaver 1977 107 p
Avail: Univ. Microfilms Order No. 7800112

The study, deals in two areas of the relationship of nuclear physics to astrophysics, namely the dense nuclear matter of neutron star cores and the possibility of the existence of collapsed nuclei. In the two sections neutrino (and antineutrino) emission from neutron star solid cores (and therby, neutron star cooling) is discussed, and possible astrophysical consequences of certain exotic nuclear states is also discussed. Dissert. Abstr.

N78-22003 Stanford Univ., Calif.
SHIELDING BY A SURFACE LAYER OF ELECTRONS, 1. WEAK ELECTROMAGNETIC FIELDS NEAR A BLACK HOLE, 2. Ph.D. Thesis
Richard Squier Hanni 1977 95 p
Avail: Univ. Microfilms Order No. 7802167

An idealized model was used to develop a perturbation calculation for shielding of the uniform electric field produced by the gravitational compression of the ionic lattice. This method avoids the complexities of the surface chemistry by neglecting the band structure and considering the shielding as a function of temperature, charge density, and the statistics of the surface layer. Weak electromagnetic fields near a black hole are weak in the sense that their effect on the spacetime curvature is small compared to that due to the mass of the hole. A multipole expansion was derived for highly symmetric weak field solutions in the Schwarzschild background. This analysis was applied to a test charge, an asymptotically uniform magnetic field, and a ring of current centered about the black hole. Particular attention was paid to the behavior of the lines of force at the horizon and the transition to a monopole field as the test charge was brought closer to the black hole. Dissert. Abstr.

N78-22004 City Univ. of New York.
RELATIVISTIC NEUTRON GAS INTERACTING THROUGH A SPIN 2 FIELD AND ITS ASTROPHYSICAL APPLICATIONS Ph.D. Thesis
Bhaskar Datta 1978 166 p
Avail: Univ. Microfilms Order No. 7802117

A Lagrangian formalism for an interacting massive spin 2 field is presented. As a model for super-dense matter, a system of zero temperature neutrons interacting via exchange of scalar, vector and spin 2 mesons are studied. The thermodynamic properties of the system are calculated in the relativistic Hartree approximation. The resulting equation of state is used to compute the bulk properties of a neutron star. The maximum mass and moment of inertia for a stable neutron star are found to be 1.75 M sub circled dot(M sub circled dot = solar mass) and 1.68 times 10 to the 45th power gm sq cm. The corresponding radius is found to be 10.7 km. It was found that the inclusion of the spin 2 interaction narrows the divergence of the existing relativistic and nonrelativistic theories in their prediction of masses and moments of inertia for neutron stars. Dissert. Abstr.

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

N78-22005 Cornell Univ., Ithaca, N. Y.
ON THE THEORY AND ANALYSIS OF OCCULTATION LIGHT CURVES Ph.D. Thesis
Richard Gordon French 1977 217 p
Avail: Univ. Microfilms Order No. 78-01655

A propagating wave interpretation is examined for the temperature profile features observed in the Jovian upper atmosphere, during the 1971 occultation of Beta Scorpii by Jupiter. It was demonstrated that sharp intensity variation in the Beta Sco light curve need not imply abrupt, short scale refractivity fluctuations in the atmosphere, and are consistent with focusing caused by long wavelength refractivity perturbations of small amplitude. The characteristics of the resulting curves are determined. An inversion technique for obtaining temperature, pressure, and number density profiles of a planetary atmosphere from an occultation light curve is described. Assumptions are presented about the atmosphere, optics, and noise and develop the equations for temperature, pressure, and number density and their associated errors. Numerical results are presented for the special case of inversion of a noisy isothermal light curve. An example of the inversion method is shown. Dissert. Abstr.

N78-22006*# National Aeronautics and Space Administration, Washington, D. C.
STANDARD TECHNIQUES FOR PRESENTATION AND ANALYSIS OF CRATER SIZE-FREQUENCY DATA
Apr. 1978 25 p
(NASA-TM-79730) Avail: NTIS HC A02/MF A01 CSCL 03B

In September 1977, a crater studies workshop was held for the purpose of developing standard data analysis and presentation techniques. This report contains the unanimous recommendations of the participants. This first meeting considered primarily crater

size-frequency data. Future meetings will treat other aspects of crater studies such as morphologies. Author

N78-22007*# Avco Research and Systems Group, Wilmington, Mass.
STUDY OF THE ABLATIVE EFFECTS ON TEKTITES: ATMOSPHERE ENTRY OF A SWARM OF TEKTITES Final Report, Mar. 1976 - Jan. 1977
Paavo Sepri and Karl K. Chen Feb. 1977 40 p refs
(Contract NAS5-22983)
(NASA-CR-156733; AVSD-0041-77-CR) Avail: NTIS HC A03/MF A01 CSCL 03B

The large variety of ablation markings observed on recovered tektites lead to the previously proposed swarm wake model which states that the lead peripheral tektites bore the blunt of aerodynamic heating upon entry, and that the bulk of tektites in the wake enjoyed partial shielding at the expense of the leaders. Further considerations are presented in support of this model. Quantitative assessments indicate that wake shielding might indeed have provided for substantially less heating than would have been experienced by a tektite entering an undisturbed atmosphere along a similar trajectory. For the case of strong wake shielding it is even possible that the surface temperature of a falling tektite had barely reached its melting point. In the distribution of tektites, there is a size band (near R = 0.5 cm) which is least susceptible to melting. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N78-22008 California Univ., Los Angeles.
NON-RADIAL p MODE OSCILLATIONS AS A SEISMIC PROBE OF SOLAR STRUCTURE Ph.D. Thesis
Edward Joseph Rhodes, Jr. 1977 327 p
Avail. Univ. Microfilms Order No. 77-30955

Digital observations of the solar photospheric velocity field are analyzed to identify the solar five-minute oscillations as global non-radial p mode oscillations of the whole sun. This observational configuration of the identity of the five-minute oscillations as the photospheric component of large-scale trapped sub-photospheric acoustic waves is based upon the excellent agreement of theoretically-calculated p mode eigenfrequencies. The global nature of the p mode oscillations is then utilized as a seismic probe of the invisible solar interior. Two fundamental results are obtained from this seismic probing: (1) the solar convective envelope is deeper than previously believed, with a base radius of 0.6 R, or a depth of 0.4 R, and (2) the standing-wave nature of the p mode oscillations allows them to serve as indicators of the surface and sub-surface rotational rates of the sun. Other analogies between solar and ground-based seismology are also presented and the additional information which can be obtained from multiple-location observations is outlined. Dissert. Abstr.

N78-22009 Utah State Univ., Logan.
ANALYSIS OF EUV SOLAR LINE PROFILES OF Si-2 AND Si-3 Ph.D. Thesis
David Arthur Tripp 1977 127 p
Avail: Univ. Microfilms Order No. 7730668

A synthesis of observed solar line profiles in the EUV of Si-II and Si-III is made. Results of this kinetic equilibrium calculation show that the model atmosphere proposed by Vernazza, et al., appears to be, so far as the temperature and density distributions are concerned, generally correct. An analysis of various types of microturbulence distributions is made in an attempt to better fit the observations. The best fit to the observed spectral lines is achieved using a microturbulence distribution that is proportional to the square of the temperature. Inference is drawn therefore to the solar chromosphere being heated by acoustical waves. Dissert. Abstr.

N78-22010 Maryland Univ., College Park.
A STUDY OF THE PROPAGATION AND INTRINSIC CHARACTERISTICS OF FLARE-ASSOCIATED PARTICLE EVENTS Ph.D. Thesis
Linda Ling-sung MaSung 1977 257 p
Avail: Univ. Microfilms Order No. 7730541 CSCL 03B

A detailed study of the propagation characteristics of some 50 solar particle events is carried out using the 4-80 MeV proton and the 0.5-1.1 MeV and 3-12 MeV electron data from the Goddard Cosmic Ray Experiments on IMPs IV and V which covered the maximum of solar cycle 20 from May, 1967, to December, 1972. Some 185 particle events were detected, approximately 68% of which were associated with solar flares, X-rays and radio bursts. Most of the unidentified increases probably occurred on the backside of the sun. Based on the results of this analysis, the exponential decay of particle events appears to be an interplanetary phenomenon caused by focused diffusion. The long decay of some eastern events associated with a long coronal injection may be indication of propagation of particles in regions of space where focusing is less intense. Dissert. Abstr.

N78-22011 Harvard Univ., Cambridge, Mass.
THE STRUCTURE OF THE SOLAR TRANSITION REGION AND INNER CORONA Ph.D. Thesis
John Thomas Mariska 1977 192 p
Avail: Univ. Microfilms Order No. 7803431

Emission gradient curves for extreme ultraviolet resonance lines of lithium-like ions were constructed from spectroheliograms of quiet limb regions and a north polar coronal hole observed with the Harvard experiment on Skylab. The observations are interpreted with simple coronal models. The coronal models are extended downward and the calculated emission from them is compared with averaged, network and cell line intensities to derive models in a quiet region and a coronal hole. The energy balance implications of the models are examined. In the transition region both conduction and radiation are important in determining the energy balance in network regions in both quiet areas and coronal holes. Additional energy sources are required in the network in coronal holes. In the corona, the energy losses, and hence the requirements for mechanical heating, are the same in quiet regions and coronal holes. Dissert. Abstr.

N78-22012*# Harvard Radio Astronomy Station, Fort Davis, Tex.
EXPERIMENTAL SOLAR RADIO SPECTRUM ANALYZER (50-100 MHz) Final Report
Alan Maxwell 15 Apr. 1978 6 p
(Grant NsG-7391)
(NASA-CR-156079) Avail: NTIS HC A02/MF A01 CSCL 03B

Summarized is the work carried out under a NASA Grant covering the period 15 October 1977 to 14 January 1978. The grant provided funds for the acquisition of an experimental radio spectrum analyzer covering the band 50-100 MHz, for use in a program of solar radio observations. Components for the experimental analyzer were duly obtained, and the system was assembled, checked, and put into operation in early February 1978. The analyzer is working in an entirely satisfactory manner and, from the time that it has been put into operation, it has played an important part in the on-going research programs in solar radio astronomy being conducted. Author

N78-22013# McMath-Hulbert Observatory, Pontiac, Mich.
SURVEY AND COMPARISON OF SOLAR ACTIVITY AND ENERGETIC PARTICLE EMISSION IN 1970
H. W. Dodson-Prince, E. R. Hedeman, and O. C. Mohler Hanscom AFB, Mass. AFGL 30 Sep. 1977 39 p
(Contract F19628-76-C-0240)
(AD-A048479; SR-1; AFGL-TR-77-0222) Avail: NTIS HC A03/MF A01 CSCL 03/2

Solar activity in 1970 was at a relatively high level with the number of major flares and important centers of activity reaching maximum numbers for all of cycle 20. Satellite data, primarily from Explorer 41, provided evidence for at least 152 distinct energetic particle enhancements during the year. These events have been compared with concurrent solar activity. All but one of the 13 particle events associated with Polar Cap Absorption in 1970 have been identified with specific solar flares. For the 50 proton events with energies 19-80 or =60 MEV, 72 percent have reasonably sure solar or geophysical sources. Of the 59 purely low energy particle events (1-10 MEV) only

39% could be assigned probable solar associations. For the numerous low-energy particle events without confident solar associations, there were assorted time coincidences with geomagnetic storms, sector boundary passages, the development of new regions on the disk, and the central meridian passage of significant centers of activity. At the present time, the significance of these solar and geophysical phenomena for particle enhancement is not known. GRA

N78-22014# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 398, OCTOBER 1977. PART 1, PROMPT REPORTS: DATA FOR SEPTEMBER - AUGUST 1977
Helen E. Coffey Oct. 1977 130 p 2 Vol.
(PB-275858/9; SGD-398-Pt-1; NOAA-77112301) Avail: NTIS HC A07/MF A01 CSCL 03B

Data is provided for September 1977 on: alert period, daily solar indices, solar flares, solar radio waves, coronal holes, solar X-ray radiation, solar wind measurements, inferred IP magnetic field polarities, mean solar magnetic field, and solar proton event (Provisional). It also provides data for Aug. 1977 on: daily solar activity centers, sudden ionospheric disturbances, solar radio waves, cosmic rays, geomagnetic indices, and radio propagation indices. GRA

N78-22015# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 398, OCTOBER 1977. PART 2, COMPREHENSIVE REPORTS: DATA FOR APRIL - MAR. 1977 AND MISCELLANEA
Helen E. Coffey Oct. 1977 51 p 2 Vol.
(PB-275859/7; SGD-398-Pt-2; NOAA-77112302) Avail: NTIS HC A04/MF A01 CSCL 03B

This comprehensive report for April 1977, March 1977, and miscellaneous data provides data on: active regions, synoptic solar maps, solar flares, solar radio waves, energetic solar particles and plasma, solar X-ray radiation, synoptic chart, abbreviated calendar record, solar radio waves for June and July 1977, and geomagnetic indices for July 1977. GRA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N78-22016*# California Univ., San Diego, La Jolla. Dept. of Physics.
HARD X-RAY IMAGING FACILITY FOR SPACE SHUTTLE: A SCIENTIFIC AND CONCEPTUAL ENGINEERING STUDY
Laurence E. Peterson, H. S. Hudson, G. Hurford (Calif. Inst. of Tech., Pasadena), and D. Schneible (Ball Bros. Res. Corp., Boulder, Colo.) Nov. 1976 157 p refs Prepared by Hard X-ray Imaging Facility Definition Team
(Contract NAS5-22375)
(NASA-CR-156736) Avail: NTIS HC A08/MF A01 CSCL 03B

A shuttle-accommodated instrument for imaging hard X-rays in the study of nonthermal particles and high temperature particles in various solar and cosmic phenomena was defined and its feasibility demonstrated. The imaging system configuration is described as well as the electronics, aspect systems, mechanical and thermal properties and the ground support equipment. Author

N78-22017*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA-RAY ASTRONOMY AND THE ORIGIN OF COSMIC RAYS
Floyd William Stecker Apr. 1978 34 p refs Submitted for publication
(NASA-TM-79535) Avail: NTIS HC A03/MF A01 CSCL 03B

New surveys of galactic gamma ray emission together with millimeter wave radio surveys indicated that cosmic rays were produced as the result of supernova explosions in our galaxy with the most intense production occurring in a Great Galactic Ring about 35,000 light years in diameter where supernova remnants and pulsars were concentrated. Author

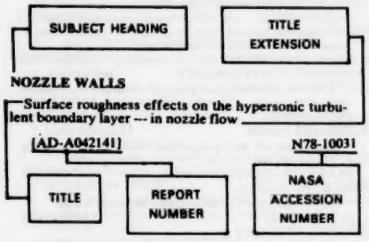
99 GENERAL

N78-22018# National Science Foundation, Washington, D. C.
NATIONAL SCIENCE FOUNDATION Annual Report 1976 141 p
(NSF-77-1; AR-26) Avail: NTIS MF A01; SOD HC $3.00

A broad record of the National Science Foundation's support of research in areas ranging from the most fundamental investigation of quantum properties of matter to applied research dealing with natural disasters, environmental quality, and weather and climate is presented. The Foundation's role in science education, science manpower analysis, and science policy studies are also discussed. Topics covered include: mathematical and physical sciences, and engineering; astronomical, atmospheric, and geophysical sciences; biological, behavioral, and social sciences; science education; research applied to national needs; and scientific, technological, and international affairs. Patents and inventions resulting from activities supported by the Foundation are listed, as well as contractors for national research centers and NSF personnel. The 1976 financial report is included.A.R.H.

SUBJECT INDEX

Typical Subject Index Listing



The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7050).

A

ABEL FUNCTION
Application and numerical solution of Abel-type integral equations
[AD-A049396] N78-21861
ABLATION
Study of the ablative effects on tektites: Atmosphere entry of a swarm of tektites --- shielding by hypersonic wake
[NASA-CR-156733] N78-22007
ABSORPTION CROSS SECTIONS
Long range interactions between atoms absorbed on surfaces
N78-21944
ABSORPTIVITY
Prospects for studying gas chemisorption kinetics using current fluctuations
N78-21953
ABSTRACTS
Utilization of lunar materials and expertise for large scale operations in space: Abstracts --- lunar bases and space industrialization
[NASA-CR-156167] N78-21180
ACCELERATION TOLERANCE
Protection of the cardiopulmonary systems against the injurious effects of acceleration
[AD-A050142] N78-21755
ACCELEROMETERS
Effect of attitude control thruster induced structural vibrations on sensed accelerations of a space vehicle
[LA-6965-MS] N78-21201
Test and development of inflatable spheres instrumented with miniaturized thermistors, accelerometers and pressure transducers
[NASA-CR-2968] N78-21428
ACCEPTOR MATERIALS
Optical conversion processes
[AD-A049583] N78-21448
ACOUSTIC DELAY LINES
Cryogenically-cooled microwave acoustic relay devices
[AD-A049765] N78-21382
ACOUSTIC EMISSION
Propellant burning rate and combustion uniformity identified by ultrasonic acoustic emissions
[AD-A049942] N78-21308
ACOUSTIC MEASUREMENTS
Audible and ultrasonic acoustic emissions from composite solid propellants
[AD-A049517] N78-21304
Acoustic remote probing of the environment --- atmospheric and underwater acoustic data acquisition
N78-21542
ACOUSTIC VELOCITY
Determination of sound velocity in liquid metals at temperatures above 4000 K
[UCRL-79322-REV-1] N78-21285
ACOUSTICS
Installation and test of Doppler acoustic sensor
[AD-A049562] N78-21893
ACTIVATION
LANDSAT-C flight activation plan
[E78-10106] N78-21512
ACTUATORS
Preliminary design analysis for the solar optical telescope main mirror actuator
[NASA-CR-156701] N78-21999
ADAPTIVE CONTROL
Adaptive training of perceptual motor skills: Issues, results and future directions
[AD-A050461] N78-21765
ADDITIVES
Parabolic profiling by the molecular stuffing process
N78-21908
Continued development of doped-germanium photoconductors for astronomical observations at wavelengths from 30 to 120 micrometers
[NASA-CR-152125] N78-22000
ADHESIVE BONDING
Fatigue in adhesively bonded laminates --- aluminum alloy laminates
[AD-A049529] N78-21271
ADIABATIC CONDITIONS
The measurement of film cooling effectiveness on turbine components in short duration wind tunnels
N78-21152
ADMIXTURES
Activation analysis of admixtures in certain semiconductive materials
[NASA-TM-75258] N78-21231
AERIAL PHOTOGRAPHY
Metric remote sensing experiments in preparation for Spacelab flights --- alpine geomorphology and ice and/or snow cover
[NASA-TM-75093] N78-21571
AERIAL RECONNAISSANCE
The use of satellite imagery for highway engineering in overseas countries
[PB-276669/9] N78-21328
AERODYNAMIC CHARACTERISTICS
Subsonic longitudinal and lateral-directional static aerodynamic characteristics for a close-coupled wing-canard model in both swept back and swept forward configurations
[NASA-TM-74092] N78-21049
Comparison of aerodynamic data measured in air and Freon-12 wind-tunnel test mediums
[NASA-TM-78671] N78-21052
Low-speed aerodynamic characteristics from wind-tunnel tests of a large-scale advanced arrow-wing supersonic-cruise transport concept
[NASA-CR-145280] N78-21053
Effect of high lift flap systems on the conceptual design of a 1985 short-haul commercial STOL tilt rotor transport
[NASA-TM-78474] N78-21094
Effects of film injection on performance of a cooled turbine
N78-21147
The influence of jets of cooling air exhausted from the trailing edges of a supercritical turbine cascade on the aerodynamic data
N78-21148
System optimization by periodic control
[AD-A049522] N78-21162
AERODYNAMIC FORCES
Problems concerning high temperatures in small turbomachines
N78-21121
AERODYNAMIC LOADS
Unsteady two dimensional airloads acting on oscillating thin airfoils in subsonic ventilated wind tunnels
[NASA-CR-2967] N78-21059
AERODYNAMIC STABILITY
Effect of leading-edge contour and vertical-tail configuration on the low-speed stability characteristics of a supersonic transport model having a highly-swept arrow wing
[NASA-TM-78683] N78-21051
AERODYNAMICS
AGARD highlights --- flight mechanics activities
[AGARD-HIGHLIGHTS-78/1] N78-21046
Numerical study of transonic flow over oscillating airfoils using the full potential equation
[NASA-TP-1120] N78-21055
AERONAUTICAL ENGINEERING
AGARD highlights --- flight mechanics activities
[AGARD-HIGHLIGHTS-78/1] N78-21046
AEROSOLS
Generation of a monodispersed aerosol
[NASA-CR-152133] N78-21445
A preliminary study of aerosol initiated CO2 laser produced air sparks and their ability to guide electrical discharges
[AD-A050097] N78-21453
Comparison of the 3-5 micrometer and 8-12 micrometer regions for advanced thermal imaging systems: LOWTRAN revisited
[AD-A049448] N78-21697
AEROSPACE ENGINEERING
Titanium/beryllium laminates: Fabrication, mechanical properties, and potential aerospace applications
[NASA-TM-73891] N78-21221
AEROSPACE ENVIRONMENTS
Space Processing Applications Rocket project SPAR III
[NASA-TM-78137] N78-21189
AEROSPACE MEDICINE
Tsiolkovsky's Ideas on Cosmonautic Problems
[NASA-TT-F-16118] N78-21177
Aerospace Medicine and Biology: A continuing bibliography with indexes, supplement 178
[NASA-SP-7011[178]] N78-21750
Microprocessor-based cardiopulmonary monitoring system
[NASA-CR-151688] N78-21752
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 24
[JPRS-70928] N78-21761
AEROSPACE SYSTEMS
Morphology of design of aerospace systems with inclusion of human factors
[AD-A049999] N78-21973
AEROSPACE TECHNOLOGY TRANSFER
Applications notice --- application of space techniques to earth resources, environment management, and space processing
[AN-OSTA-78-A] N78-21991
AFTERBURNING
Low frequency combustion instability in augmentors
N78-21138
AGGLOMERATION
Theory of large agglomerates in magnetic colloids
N78-21921
AGING [MATERIALS]
The effect of varying quench rates and heating rates on the aging response of an aluminum powder alloy
[AD-A049744] N78-21272
AGING [METALLURGY]
Composition of eta carbide in Hastelloy N after aging 10000 hr at 815 C
[ORNL-5340] N78-21283
AGRICULTURE
The use of LANDSAT digital data and computer-implemented techniques for an agricultural application
[NASA-RP-1016] N78-21568
A model of the 0.4-GHz scatterometer --- used for agriculture soil moisture program
[NASA-CR-151693] N78-21574
AIR CONDITIONING
Annual cycle energy system concept and application
[CONF-770870-1] N78-21647
Energy conservation via solar energy applications to multi-family and commercial structures. Volume 3: An energy, engineering and economic analysis of heating and cooling systems for multi-family structures
[PB-276131/0] N78-21657
AIR COOLING
Hot cascade test results of cooled turbine blades and their application to actual engine conditions
N78-21125
Effects of film injection on performance of a cooled turbine
N78-21147

The influence of jets of cooling air exhausted from the trailing edges of a supercritical turbine cascade on the aerodynamic data
N78-21148

AIR FILTERS
Filtration model for coal fly ash with glass fabrics
[PB-276489/2] N78-21667
Inertial cascade impactor substrate media for flue gas sampling
[PB-276583/2] N78-21668

AIR FLOW
A 1/3 scale air-water pump program, analytical pump performance model. Volume 1: Key phase report
[EPRI-NP-160-VOL-1] N78-21478
Work on power-plant [air] plumes involving remote sensing of SO2
N78-21548

AIR NAVIGATION
Applications of Advances in Navigation to Guidance and Control
[AGARD-CP-220] N78-21071
One-way ranging with TACAN
N78-21079

AIR POLLUTION
Thermochemistry and kinetics of sulfur containing molecules and radicals
[PB-275721/9] N78-21247
Environmental assessment of low/medium BTU gasification
[PB-276580/8] N78-21325
Generation of a monodispersed aerosol
[NASA-CR-152133] N78-21445
Air pollution modeling
N78-21663
An assessment of an F2 or N2O4 atmospheric injection from an aborted space shuttle mission
[NASA-CR-156164] N78-21664
Filtration model for coal fly ash with glass fabrics
[PB-276489/2] N78-21667
Inertial cascade impactor substrate media for flue gas sampling
[PB-276583/2] N78-21668
Technical assessment of NOx removal processes for utility application
[PB-276637/6] N78-21670
The relation of oxidant levels to precursor emissions and meteorological features. Volume 2: Review of available research results and monitoring data, as of November 1975
[PB-275326/7] N78-21672
The relation of oxidant levels to precursor emissions and meteorological features. Volume 3: Appendices [analytical methods and supplementary data]
[PB-275327/5] N78-21673
CALINE 2: An improved microscale model for the dispersion of air pollutants from a line source
[PB-275683/1] N78-21676
Preliminary environmental assessment of combustion modification techniques. Volume 1: Summary
[PB-276680/6] N78-21677
Preliminary environmental assessment of combustion modification techniques. Volume 2: Technical results
[PB-276681/4] N78-21678
International Conference on Oxidants, 1976: Analysis of Evidence and Viewpoints. Part 1: Definition of key issues
[PB-276768/9] N78-21679
Century industrial products FRP-100 wet scrubber evaluation --- for air pollution control
[PB-276520/4] N78-21680
Review of diesel combustion models for NOx and smoke emissions
[PB-276350/6] N78-21681
American Air Filter Kinpactor 10 x 36 venturi scrubber evaluation
[PB-276716/8] N78-21682
The fate of nitrogen oxides in the atmosphere: Summary of an exploratory study in Phoenix, Arizona
[PB-276355/5] N78-21707
Empirical determination of vertical diffusion coefficients for Los Angeles
[PB-275756/5] N78-21712

AIR QUALITY
Air pollution modeling
N78-21663

AIR TRAFFIC CONTROL
Improved aircraft tracking using maneuver statistics enroute and in the terminal area
N78-21087

AIR TRANSPORTATION
Alternative future scenarios for the national system. Volume 1: Executive summary --- overview of study methods and results
[AD-A047084] N78-21065

AIR WATER INTERACTIONS
Measurement of near sea surface turbulence and possible wave influence
[AD-A049951] N78-21704
Response of the upper ocean to Hurricane Eloise
[AD-A050245] N78-21722

AIRBORNE/SPACEBORNE COMPUTERS
Synthesis and analysis of precise spaceborne laser ranging systems, volume 1 --- link analysis
[NASA-CR-156727] N78-21442
Synthesis and analysis of precise spaceborne laser ranging systems, volume 2 --- Spacelab payload
[NASA-CR-156728] N78-21443

AIRCRAFT ACCIDENT INVESTIGATION
Aircraft accident report: Southern Airways Inc., DC-9-31, N1335U, New Hope, Georgia, April 4, 1977
[NTSB-AAR-78-3] N78-21064

AIRCRAFT ANTENNAS
HF radiation characteristics of the RH-53D helicopter and the Mark 105 AMCM system
[AD-A049795] N78-21358
Multiband antenna system for tactical aircraft
[AD-A049699] N78-21363

AIRCRAFT COMPARTMENTS
Time-dependent fire behavior of aircraft cabin materials
[AD-A050923] N78-21234
Experimental and theoretical sound transmission --- reduction of interior noise in aircraft
[NASA-CR-156170] N78-21889

AIRCRAFT CONSTRUCTION MATERIALS
Evaluation of windshield materials subjected to simulated supersonic flight
[AD-A049981] N78-21101

AIRCRAFT CONTROL
Applications of Advances in Navigation to Guidance and Control
[AGARD-CP-220] N78-21071
UHF DF triangulation system for control and guidance of military aircraft
N78-21077

AIRCRAFT DESIGN
Multi-variate optimization problems of flight vehicle synthesis
[PB-276123/7] N78-21103

AIRCRAFT ENGINES
Fuel conservation merits of advanced turboprop transport aircraft
[NASA-CR-152096] N78-21095
A review of techniques for the thermal protection of the walls of the combustion chamber and reheating ducts of turboreactors
N78-21134
Lightweight, low compression aircraft diesel engine --- converting a spark ignition engine to the diesel cycle
[NASA-CR-135300] N78-21471

AIRCRAFT EQUIPMENT
Design, fabrication, and testing of a full-scale breadboard in nitrogen generator for fuel tank inerting application
[AD-A049459] N78-21097
A model of the 0.4-GHz scatterometer --- used for agriculture soil moisture program
[NASA-CR-151693] N78-21574

AIRCRAFT FUELS
Fuel conservation merits of advanced turboprop transport aircraft
[NASA-CR-152096] N78-21095
The vaporization behavior of a fuel drop on a hot surface --- aircraft fuel drop evaporation
[AD-A049471] N78-21303

AIRCRAFT GUIDANCE
Navigation, guidance and control for high performance military aircraft
N78-21090

AIRCRAFT HAZARDS
Fire resistivity and toxicity studies of candidate aircraft passenger seat materials
[NASA-TM-78468] N78-21214
Aircrew and passenger protective breathing equipment studies
[AD-A051002] N78-21768

AIRCRAFT INSTRUMENTS
APL radiometer wind tunnel test program with simulated aircraft radome
[BSR-4230] N78-21402

AIRCRAFT LANDING
Response to actual and simulated recordings of conventional takeoff and landing jet aircraft
[NASA-CR-145318] N78-21890

AIRCRAFT MAINTENANCE
A life cycle cost study of contractor versus organic support of aircraft programs
[AD-A049438] N78-21045

AIRCRAFT NOISE
Experimental and theoretical sound transmission --- reduction of interior noise in aircraft
[NASA-CR-156170] N78-21889
Response to actual and simulated recordings of conventional takeoff and landing jet aircraft
[NASA-CR-145318] N78-21890
Airport and aircraft noise reduction
[GPO-91-591] N78-21891

AIRCRAFT RELIABILITY
Research requirements to improve reliability of civil helicopters
[NASA-CR-145335] N78-21093

AIRCRAFT SAFETY
Investigation to support phase 1 of the USAF midair prevention systems program [MAPS]
[AD-A049743] N78-21066
Bearing study program --- bearing measurement subsystem for SECANT Collision Avoidance System
[AD-A049767] N78-21068
Aircrew and passenger protective breathing equipment studies
[AD-A051002] N78-21768

AIRCRAFT STRUCTURES
Report on aircraft fatigue studies --- in-flight monitoring and stress measurements
[AD-A049876] N78-21102
Experimental and theoretical sound transmission --- reduction of interior noise in aircraft
[NASA-CR-156170] N78-21889

AIRCRAFT SURVIVABILITY
A review of methodologies and concepts to measure and evaluate aircraft survivability/vulnerability
[AD-A050152] N78-21099

AIRCRAFT TIRES
Definition of tire properties required for landing system analysis
[NASA-CR-156171] N78-21326

AIRCRAFT WAKES
Installation and test of Doppler acoustic sensor
[AD-A049562] N78-21893

AIRFOIL PROFILES
Airfoil profile in a nonuniform flow
[NASA-TM-75272] N78-21048

AIRFOILS
Numerical study of transonic flow over oscillating airfoils using the full potential equation
[NASA-TP-1120] N78-21055
Unsteady two dimensional airloads acting on oscillating thin airfoils in subsonic ventilated wind tunnels
[NASA-CR-2967] N78-21059
Unsteady, surface pressure and near-wave hotwire measurements of a circulation control airfoil
[AD-A050025] N78-21061
Transonic wind tunnel tests on two-dimensional aerofoil sections. Determination of pressure distribution and drag for an aerofoil with a modified NACA 65 sub2-215 section in FFA wind tunnel S5, part 2
[FFA-TN-AU-725] N78-21062

AIRFRAME MATERIALS
Environmental effects on crack growth in flight-simulation tests on 2024-T3 and 7075-T6 material
[NLR-TR-76104-U] N78-21492

AIRFRAMES
A-4F Blue Angel flight usage data, 1976
[AD-A050164] N78-21100
Airflow and thrust calibration of an F100 engine, S/N P680059, at selected flight conditions
[NASA-TP-1069] N78-21112

AIRLINE OPERATIONS
Airport and aircraft noise reduction
[GPO-91-591] N78-21891

AIRPORTS
Airport and aircraft noise reduction
[GPO-91-591] N78-21891

ALASKA
Alaskan oil transportation issues
[PB-276449/6] N78-21661

ALGAE
Antifouling activity of phytotoxic compounds and experimental polymeric algicides
[MRL-R-698] N78-21747
Algae, ultraviolet light, and the production of trace gases
[AD-A049441] N78-21748

ALGORITHMS
Numerical results or multiconductor transmission line networks
[AD-A049451] N78-21349
Performance measurements of the CVSD speech coding algorithm
[AD-A050163] N78-21362
GEOFAST: A fast gravimetric estimation algorithm
[AD-A047611] N78-21706
Use of Floyd's algorithm to find shortest restricted paths
[AD-A049467] N78-21797
A hybrid approach to multi-stage linear programs
[AD-A049477] N78-21798
Thinning algorithms for grayscale pictures
[AD-A049587] N78-21800
Algorithms and hardware technology image recognition
[AD-A049590] N78-21803
At the interface of modeling and algorithms research
[AD-A049757] N78-21806
Multicriteria integer zero-one programming: A tree-search type algorithm
[AD-A050244] N78-21807
Algorithms for computing repair schedules in probabilistic environments
[AD-A049554] N78-21809
MINKIT: An optimization system
[ANL-AMD-TM-305] N78-21817

An efficient algorithm for choosing the degree of a polynomial to approximate discrete nonoscillatory data
[NASA-TM-72854] N78-21839
ALKALI VAPOR LAMPS
Research investigation directed toward extending the useful range of the electromagnetic spectrum
[NASA-CR-156069] N78-21236
ALKALIES
Study of soft alkaline using LANDSAT images of pools and residue with an emphasis on radioactive materials --- Brazil
[E78-10104] N78-21510
ALL-WEATHER AIR NAVIGATION
Development of the integrated all-weather navigation system for tornado [MRCA]
N78-21089
ALL-WEATHER LANDING SYSTEMS
A hybrid guidance system for all-weather approach and landing
N78-21088
ALLOYS
Method of plastic deformation of metals and alloys
[AD-A049391] N78-21280
ALPHA PARTICLES
Determination of boron and lithium by recording the products from [n, alpha] reactions
[NASA-TM-75260] N78-21904
Bounce effects in the instability theory of trapped alpha particles in the Tokamak reactor
[ERDA-TR-313] N78-21933
ALPS MOUNTAINS [EUROPE]
Metric remote sensing experiments in preparation for Spacelab flights --- alpine geomorphology and ice and/or snow cover
[NASA-TM-75093] N78-21571
ALTIMETERS
Remote sensing of Gulf Stream using GEOS-3 radar altimeter
[NASA-TP-1209] N78-21737
ALUMINUM
Wear of single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1198] N78-21295
ALUMINUM ALLOYS
Fatigue in adhesively bonded laminates --- aluminum alloy laminates
[AD-A049529] N78-21271
The effect of varying quench rates and heating rates on the aging response of an aluminum powder alloy
[AD-A049744] N78-21272
Pitting in aluminum --- copper cathode formation
[AD-A049854] N78-21274
Effects of thermo-mechanical processing on aluminum-magnesium alloys containing high weight percentage magnesium
[AD-A050092] N78-21275
Optical surface studies of titanium and titanium-aluminum alloys with application to the mechanism of passivity and non-destructive testing
[AD-A050212] N78-21276
Structure and deformation characteristics of rheocast metals --- tin and aluminum alloys
[AD-A049975] N78-21279
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 1: Program summary and data analysis
[NASA-CR-135369] N78-21493
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 2: Crack opening displacement and stress-strain data
[NASA-CR-135370] N78-21494
Shear strength of fillet welds in aluminum alloy 2219 --- for use on the solid rocket motor and external tank
[NASA-TM-78168] N78-21495
ALUMINUM COMPOUNDS
Variation of interdiffusion coefficient and ratio of intrinsic diffusion coefficients with composition in the NiAl [delta] phase of the Al-Ni system
N78-21257
Development of SiAlON materials
[NASA-CR-135290] N78-21289
ALUMINUM OXIDES
Formulation of electrically conductive thermal-control coatings
[NASA-TP-1218] N78-21216
Microstructure evolution during sintering of beta - alumina compositions
N78-21258
Erosion of brittle materials by solid particle impact
[AD-A050252] N78-21296
AMORPHOUS MATERIALS
Theory of amorphous CuNi alloys
N78-21250
Superconductivity, spin-glass properties, and ferromagnetism in amorphous La-Gd-Au alloys
N78-21951
ANALOGIES
Atmospheric diffusion: Similarity theory and empirical derivations for use in boundary layer diffusion problems
[AD-A050027] N78-21701
ANALYSIS [MATHEMATICS]
Contributions to the dimensional theory
N78-21835
Approximate solutions for certain optimal stopping problems
[AD-A049995] N78-21856
Approximate solutions for certain optimal stopping problems
[AD-A049556] N78-21878
ANALYTIC GEOMETRY
Analytical determination of the Burmester lines for cylindric-cylindric cranks
N78-21465
ANISOTROPIC MEDIA
Asymptotically derived cylindrical shell theories with application to anisotropic composite materials
N78-21488
ANISOTROPIC SHELLS
Asymptotically derived cylindrical shell theories with application to anisotropic composite materials
N78-21488
ANNULAR NOZZLES
Wind tunnel performance tests of coannular plug nozzles --- in the Langley 8 x 6 ft. supersonic wind tunnel
[NASA-CR-2990] N78-21044
ANODES
Effect of anode-cathode geometry on performance of the HIP-1 hot ion plasma --- magnetic mirrors
[NASA-TP-1201] N78-21922
ANOMALIES
Dynamical numerical prediction of large-scale thermal anomalies in the North Pacific Ocean
[AD-A049919] N78-21740
Anomalous infrared emission from condensing and cooling steam clouds
[AD-A050083] N78-21914
ANTARCTIC REGIONS
Temperature fine-structure in the Southern Ocean
N78-21735
ANTENNA ARRAYS
The circumferential variation of the axial component of the current in closely spaced thin-wire antennas
[AD-A049456] N78-21351
ANTENNA DESIGN
Multiband antenna system for tactical aircraft
[AD-A049699] N78-21363
ANTENNA RADIATION PATTERNS
Experimental validation of the Antenna Pattern Distortion Computer Program, VHF antenna
[AD-A049740] N78-21345
Efficient computation of radiation patterns and contour beam synthesis using reflector antennas
[AD-A050132] N78-21361
Multiband antenna system for tactical aircraft
[AD-A049699] N78-21363
Design of two high gain, low profile helical antennas for operation at 918 MHz
[AD-A049950] N78-21386
Low profile, printed circuit antennas
[AD-A047629] N78-21389
ANTENNAS
Antenna selection for ionospheric telecommunication systems
[AD-A049549] N78-21364
Low profile, printed circuit antennas
[AD-A047629] N78-21389
APERTURES
Analysis of synthetic aperture radar imagery
[NASA-CR-156743] N78-21339
APOLLO PROJECT
Apollo over the moon: A view from orbit
[NASA-SP-362] N78-21174
APPLICATIONS EXPLORER SATELLITES
HCMM satellite to take earth's temperature
[NASA-NEWS-RELEASE-78-60] N78-21507
APPLICATIONS OF MATHEMATICS
New computation method of turbine blades film cooling efficiency
N78-21154
Calculation of temperature distribution in disks and cooling flow in a transient state
N78-21157
Mathematics of operations research
[AD-A049700] N78-21853
APPLICATIONS PROGRAMS [COMPUTERS]
Multi-item scheduling in reparable item inventory systems with reflection programming
[AD-A049553] N78-21808
Algorithms for computing repair schedules in probabilistic environments
[AD-A049554] N78-21809
APPROACH
A hybrid guidance system for all-weather approach and landing
N78-21088
APPROACH CONTROL
A 4D approach control using VOR/DME/ILS guidance
N78-21083
Optimal control theory [OWEM] applied to a helicopter in the hover and approach phase
[NASA-CR-152135] N78-21161
APPROPRIATIONS
A range of cost measuring risk and uncertainty in major programs: An aid to decision making --- for federal funding
[PB-276384/5] N78-21979
APPROXIMATION
Accuracy limitation on strapdown calculations in a coning environment due to a given approximation to the body rate vector
[SAND-77-0726] N78-21069
Finite viscoplastic deflections of an impulsively loaded plate by the mode approximation technique
[AD-A049827] N78-21499
Approximate solutions for certain optimal stopping problems
[AD-A049995] N78-21856
A road map of methods for approximating solutions of two-point boundary-values problems
[AD-A049971] N78-21858
APTITUDE
Code of practice for welding. Part 5: Welders' competence tests for manual oxy-acetylene, manual metal-arc, manual gas-shielded tungsten-arc, and manual gas-shielded metal-arc welding of mild steel [carbon steel] and medium high tensile steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-5-1976-REV-1]
N78-21467
AQUIFERS
Aquifer test analyses for the Floridan aquifer in Flagler, Putnam, and St. Johns counties, Florida
[PB-275790/4] N78-21583
ARC WELDING
Code of practice for welding. Part 5: Welders' competence tests for manual oxy-acetylene, manual metal-arc, manual gas-shielded tungsten-arc, and manual gas-shielded metal-arc welding of mild steel [carbon steel] and medium high tensile steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-5-1976-REV-1]
N78-21467
ARCHITECTURE
Computer Family Architecture Selection Committee. Volume 3: Evaluation of computer architecture via test programs
[AD-A049482] N78-21773
Computer Family Architecture Selection Committee. Volume 4: Architectural research facility ISP description, simulations, data collection
[AD-A049483] N78-21774
Computer Family Architecture Selection Committee. Volume 5: Procedure for and results of the evaluations of software bases of the candidate architectures for the military computer family
[AD-A049484] N78-21775
Computer family architecture selection committee. Volume 2: Selection of candidate architectures and initial screening
[AD-A049457] N78-21779
ARCHITECTURE [COMPUTERS]
Computer family architecture selection committee. Volume 8: CFA final selection
[AD-A049485] N78-21777
Computer family architecture selection committee. Volume 9: A consideration of issues in the selection of a computer family architecture
[AD-A049486] N78-21778
Computer family architecture selection committee. Volume 1: Introduction
[AD-A049468] N78-21782
A survey of computer architectures for image processing and pattern recognition
[AD-A049536] N78-21784
L-STAR: An interactive, symbolic implementation system
[AD-A050119] N78-21785
Development and application of data processing and pattern recognition methods
[AD-A049846] N78-21982
ARIZONA
Evaluation of LANDSAT MSS vs TM simulated data for distinguishing hydrothermal alteration
[NASA-CR-156168] N78-21569
ARRAYS
Large active retrodirective arrays for space applications
[NASA-CR-156163] N78-21333
ARROW WINGS
Effect of leading-edge contour and vertical-tail configuration on the low-speed stability characteristics of a supersonic transport model having a highly-swept arrow wing
[NASA-TM-78683] N78-21051
ARTIFICIAL GRAVITY
Simplified model of statistically stationary spacecraft rotation and associated induced gravity environments
[NASA-TM-78164] N78-21198
ARTIFICIAL SATELLITES
Biological satellite Kosmos-936
[NASA-TM-75097] N78-21192
ASHES
Filtration model for coal fly ash with glass fabrics
[PB-276489/2] N78-21667
ASSEMBLER ROUTINES
An assembly-language minicomputer software development system
[PB-276108/8] N78-21815

ASSEMBLY LANGUAGE
An assembly-language minicomputer software development system
[PB-276108/8] N78-21815
ASSESSMENTS
Environmental assessment of low/medium BTU gasification
[PB-276580/8] N78-21325
Technical assessment of NOx removal processes for utility application
[PB-276637/6] N78-21670
ASSOCIATIVE PROCESSING [COMPUTERS]
Associative array processing of raster scanned data for automated cartography II: Improved resolution and data handling
[AD-A049698] N78-21379
Matrix inversion using the RADC STARAN associative array processor
[AD-A049617] N78-21849
ASTROMETRY
Real-time, intermediate-field astrometry
[AD-A048155] N78-22001
ASTRONOMICAL CATALOGS
Real-time, intermediate-field astrometry
[AD-A048155] N78-22001
ASTRONOMICAL PHOTOMETRY
Real-time, intermediate-field astrometry
[AD-A048155] N78-22001
ASTRONOMICAL SPECTROSCOPY
Laboratory simulation of infrared astrophysical features --- silicate mixtures with emission spectra matching those of comets
N78-21998
ASTRONOMICAL TELESCOPES
Preliminary design analysis for the solar optical telescope main mirror actuator
[NASA-CR-156701] N78-21999
ASTRONOMY
Translations on USSR science and technology: Physical sciences and technology, no. 33
[JPRS-70946] N78-21183
Gamma-ray astronomy and the origin of cosmic rays
[NASA-TM-79535] N78-22017
National Science Foundation --- research projects and technology assessment
[NSF-77-1] N78-22018
ASTROPHYSICS
Considerations on dense matter in astrophysics
N78-22002
ASYMPTOTIC METHODS
Asymptotically derived cylindrical shell theories with application to anisotropic composite materials
N78-21488
Asymptotic distribution of symmetric statistics
[AD-A049395] N78-21862
ASYMPTOTIC SERIES
Some numerical results on asymptotic failure distributions
[AD-A049775] N78-21879
ATLANTIC OCEAN
World weather program. Plan for fiscal year 1978
[PB-276479/3] N78-21718
ATMOSPHERIC ATTENUATION
A depolarization and attenuation experiment using the COMSTAR and CTS satellites
[NASA-CR-156730] N78-21336
ATMOSPHERIC CHEMISTRY
Software development: Stratosphere modeling
[NASA-CR-156722] N78-21692
The fate of nitrogen oxides in the atmosphere: Summary of an exploratory study in Phoenix, Arizona
[PB-276355/5] N78-21707
ATMOSPHERIC CIRCULATION
The development of a mesoscale semi-implicit numerical model
N78-21716
A study of the characteristics of the data systems test kinematic fields
[AD-A050060] N78-21721
ATMOSPHERIC COMPOSITION
An evaluation of electrochemical concentration Cell [ECC] sonde measurements of atmospheric ozone
[NASA-CR-2973] N78-21429
Thermochemical and kinetic data of gaseous metal oxides and their relationship to atmospheric composition
[AD-A050162] N78-21700
ATMOSPHERIC DENSITY
Atmospheric diffusion: Similarity theory and empirical derivations for use in boundary layer diffusion problems
[AD-A050027] N78-21701
ATMOSPHERIC DIFFUSION
Empirical determination of vertical diffusion coefficients for Los Angeles
[PB-275756/5] N78-21712
Physical mechanisms of extra area effects from weather modification
N78-21715
ATMOSPHERIC ENTRY
Study of the ablative effects on tektites: Atmosphere entry of a swarm of tektites --- shielding by hypersonic wake
[NASA-CR-156733] N78-22007
ATMOSPHERIC MODELS
Study of vertical movement and associative precipitation by extratropical perturbations in South America
[E78-10107] N78-21513
Software development: Stratosphere modeling
[NASA-CR-156722] N78-21692
Orographic precipitation model for hydrometeorological use
N78-21714
The modification and application of Kuo's parameterization of cumulus convection in middle latitudes
[NASA-CR-2998] N78-21717
A study of the characteristics of the data systems test kinematic fields
[AD-A050060] N78-21721
ATMOSPHERIC PHYSICS
Approximate solutions to the radiative transfer equation using the Elsasser scheme
[AD-A049933] N78-21703
ATMOSPHERIC REFRACTION
Measurement of near sea surface turbulence and possible wave influence
[AD-A049951] N78-21704
USMR [White Sands Missile Range] atmospheric structure constant [C sub n, sup 2] survey
[PB-276097/3] N78-21711
ATMOSPHERIC SCATTERING
Acoustic remote probing of the environment --- atmospheric and underwater acoustic data acquisition
N78-21542
ATMOSPHERIC TURBULENCE
A numerical investigation of the boundary layer of an atmospheric mesoscale vortex
N78-21688
Measurement of near sea surface turbulence and possible wave influence
[AD-A049951] N78-21704
ATMOSPHERIC WINDOWS
Comparison of the 3-5 micrometer and 8-12 micrometer regions for advanced thermal imaging systems: LOWTRAN revisited
[AD-A049448] N78-21697
ATOMIC BEAMS
Inelastic collisions of excited atoms
[AD-A050037] N78-21901
ATOMIC COLLISIONS
Long range interactions between atoms absorbed on surfaces
N78-21944
ATOMIC EXCITATIONS
Vacuum ultraviolet and visible radiation from electron impact excitation of nitrogen, hydrogen, oxygen, the light hydrocarbons and the rare gases
N78-21897
ATOMIC SPECTRA
Research investigation directed toward extending the useful range of the electromagnetic spectrum
[NASA-CR-156069] N78-21236
ATTACK AIRCRAFT
A-4F Blue Angel flight usage data, 1976
[AD-A050164] N78-21100
ATTITUDE CONTROL
The N-BOD2 user's and programmer's manual
[NASA-TP-1145] N78-21200
AUDITORY PERCEPTION
Activation and sustained attention: A pupillometric study of an auditory vigilance task
[AD-A050040] N78-21759
AUGER SPECTROSCOPY
Analysis of Angular Dependent Auger Spectroscopy [ADAS] based on a quasiatomic model
[CONF-770908-6] N78-21966
AUSTENITE
The influence of retained austenite on the thick section mechanical properties of a commercial low alloy ultra-high strength steel
N78-21254
AUSTENITIC STAINLESS STEELS
A study of the effect of carbon upon the elevated temperature mechanical, fracture and static load crack extension behavior of austenitic stainless steel
N78-21255
Code of practice for welding. Part 7: Welders' competence tests for manual metal-arc, manual inert gas-shielded tungsten-arc, and manual inert gas-shielded metal-arc welding of austenitic stainless and austenitic heat resisting steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-7-1976] N78-21468
AUTOCORRELATION
Improved aircraft tracking using maneuver statistics enroute and in the terminal area
N78-21087
AUTOMATA THEORY
Synthesis: Dreams yield programs
[AD-A049761] N78-21814
AUTOMATIC CONTROL
Unattended/minimally attended radar study. Volume 1: Summary
[AD-A049776] N78-21346
Unattended/minimally attended radar study, volume 2
[AD-A049777] N78-21347
Laboratory automatic data acquisition system
[BDX-613-1566] N78-21435
AUTOMATIC FLIGHT CONTROL
Heavy lift helicopter flight control system. Volume 3: Automatic flight control system development and feasibility demonstration
[AD-A050059] N78-21164
AUTOMATION
A fully automated system for pulsed NMR measurements
N78-21228
AUTOMOBILE ENGINES
Hydrodynamic air lubricated compliant surface bearing for an automotive gas turbine engine. 1: Journal bearing performance
[NASA-CR-135368] N78-21472
Baseline gas turbine development program
[COO-2749-18] N78-21479
AUTOMOBILES
The automotive fuel economy standards for model year 1981-1984 passenger cars
[PB-275827/4] N78-21314
Rulemaking support paper concerning the 1981-1984 passenger auto average fuel economy standards
[PB-275895/1] N78-21315
AUTOROTATION
Windmill power for city people
[PB-275658/3] N78-21654
AUXILIARY PROPULSION
Planned flight test of a mercury ion auxiliary propulsion system. 1: Objectives, systems descriptions, and mission operations
[NASA-TM-78859] N78-21204
Planned flight test of a mercury ion auxiliary propulsion system. Part 2: Integration with host spacecraft
[NASA-TM-78869] N78-21209
AVIONICS
Multi-variate optimization problems of flight vehicle synthesis
[PB-276123/7] N78-21103
Human performance in aviation systems
[AD-A050078] N78-21771
AXIAL FLOW TURBINES
The status of small, cooled, axial-flow turbines
N78-21123
AXIAL LOADS
A biaxial method for inplane shear testing --- shear strain in composite materials
[NASA-TM-74070] N78-21489
AXISYMMETRIC BODIES
Dynamic instability analysis of axisymmetric shells by finite element method with convected coordinates
[CONF-770807-34] N78-21505

B

B-1 AIRCRAFT
Fiber Optics Cost Analysis Program [FOCAP]
[AD-A049859] N78-21105
BACKSCATTERING
User's guide to the Nimbus-4 backscatter ultraviolet experiment data sets
[NASA-TM-78069] N78-21694
Response functions in a one-dimensional Fermi gas and renormalization-group treatment of one-dimensional kondo lattices
N78-21938
BALL BEARINGS
Ball to separator contact forces in angular contact ball bearings under thrust and radial loads
[NASA-CR-2976] N78-21469
Study of surface fatigue wear by exoelectron emission
[AD-A049927] N78-21476
BALLOON-BORNE INSTRUMENTS
Tunable diode laser heterodyne spectrometer for balloon-borne solar radiometry in the stratosphere
[SAND-77-0601] N78-21463
Results of the 1974 through 1977 NASA/JPL balloon flight solar cell calibration program
[NASA-CR-156180] N78-21598
BALLS
Characterization of wear debris generated in accelerated rolling-element fatigue tests
[NASA-TP-1203] N78-21470
Rolling-element fatigue life of AISI M-50 and 18-4-1 balls
[NASA-TP-1202] N78-21473
BANACH SPACE
Averaging in Banach spaces
N78-21887
BANDWIDTH
A new approach to computer aided transient analysis of stiff linear networks
N78-21818
BARRIER LAYERS
Surface chemistry of fluoropolymer barrier films: Relation of solution variables to film properties
[AD-A050003] N78-21298
BATHYMETERS
A geophysical investigation of the oceanographer fracture zone and the mid-Atlantic ridge in the vicinity of 35 deg north
N78-21683

BEAMS [RADIATION]
Internal reflection of bounded beams: Effects in the plane of incidence
N78-21910
BEARINGLESS ROTORS
Bearingless tail rotor loads and stability
[AD-A049579] N78-21098
BERYLLIUM
Titanium/beryllium laminates: Fabrication, mechanical properties, and potential aerospace applications
[NASA-TM-73891] N78-21221
BIBLIOGRAPHIES
The use of halons as fire suppressants: A literature survey
[AD-A050098] N78-21237
Complex formation in RDX, HMX, TNT, and some related compounds: A bibliography
[AD-A050090] N78-21306
Laser hazards bibliography, August 1977 eighth edition
[AD-A047606] N78-21457
Annotated bibliography of natural resource information: Northwestern Colorado
[PB-275997/5] N78-21579
Aerospace Medicine and Biology: A continuing bibliography with indexes, supplement 178
[NASA-SP-7011[178]] N78-21750
BINARY ALLOYS
Theory of amorphous CuNi alloys
N78-21250
An X-ray study of continuous ordering and its kinetics in binary alloys
N78-21260
BINARY DATA
Global controllability for a class of bilinear systems
[AD-A049518] N78-21882
BINARY STARS
Two theoretical problems in close binary stars
N78-21995
BINARY SYSTEMS [MATERIALS]
Investigation of the turbulent flows of two-phase media
[NASA-TT-F-17059] N78-21408
BINDING
Binding energy and effectiveness mass of charged particles trapped on surfaces
[AD-A049945] N78-21964
BIOCHEMISTRY
Aerospace Medicine and Biology: A continuing bibliography with indexes, supplement 178
[NASA-SP-7011[178]] N78-21750
BIODYNAMICS
Radiographic and biomechanical studies of the human spine
[AD-A049984] N78-21758
BIOINSTRUMENTATION
Microprocessor-based cardiopulmonary monitoring system
[NASA-CR-151688] N78-21752
BIOLOGICAL EFFECTS
Tsiolkovsky's Ideas on Cosmonautic Problems
[NASA-TT-F-16118] N78-21177
Biological applications and effects of optical masers
[AD-A050057] N78-21462
Investigations of the biological effects of radiation: A multi-discipline approach
[COO-2486-366] N78-21760
BIOSATELLITES
Germination of pine seed in weightlessness [investigation in Kosmos 782]
[NASA-TM-75281] N78-21172
Biological satellite Kosmos-936
[NASA-TM-75097] N78-21192
BIRDS
Use of LANDSAT data to assess waterfowl habitat quality
[E78-10120] N78-21524
BLACK HOLES [ASTRONOMY]
Shielding by a surface layer of electrons, 1. Weak electromagnetic fields near a black hole, 2.
N78-22003
BLADES [CUTTERS]
Flo-peeling and other alternatives to conventional turning
[AD-A050123] N78-21475
BLASTS
Unsteady plume and blast field generated by a rocket launch
[AD-A050000] N78-21213
BOLOMETERS
Electron beam addressed arrays of infrared bolometers
[AD-A049550] N78-21905
BOOLEAN ALGEBRA
Boolean algebras with partitioning bases
N78-21836
BORANES
Studies of transition metal analogs of hexaborane [10]. Nuclear magnetic resonance studies of heptaborane species
N78-21349
BORON ISOTOPES
Four Workshops in Alternate Concepts in Controlled Fusion. Part A: Executive summaries. Part B: Extended summaries. Part C: CTR using the p-B-11 reaction
[EPRI-ER-429-SR-PT-A] N78-21927
BORON 10
Determination of boron and lithium by recording the products from [n, alpha] reactions
[NASA-TM-75260] N78-21904
BOUNDARIES
An applied overview of moving boundary problems
[AD-A049695] N78-21962
BOUNDARY LAYER CONTROL
Unsteady, surface pressure and near-wave hotwire measurements of a circulation control airfoil
[AD-A050025] N78-21061
BOUNDARY LAYER STABILITY
Laminar boundary layer stability measurements at Mach 7 including wall temperature effects — conical bodies
[AD-A049535] N78-21415
BOUNDARY LAYER TRANSITION
Heat transfer to a PVD rotor blade at high subsonic passage throat Mach numbers
N78-21150
Experimental study of the laminar-turbulent transition of a concave wall in a parallel flow
[NASA-TM-75243] N78-21412
Numerical calculation of the stability of parallel flows
[AD-A049983] N78-21418
High-pressure studies of soft mode transitions in solids
[SAND-77-1188C] N78-21968
BOUNDARY LAYERS
A brief examination of the flow external to an F-111 intake at Mach 1.6
[ARL/ME-NOTE-357] N78-21054
Boundary layer analysis of a Centaur standard shroud
[NASA-TM-78843] N78-21404
On the period of the coherent structure in boundary layers at large Reynolds numbers
[NASA-TM-78477] N78-21407
Catalyzed combustion in a flat plate boundary layer. 1: Experimental measurements and comparison with numerical calculations
[LBL-6841] N78-21636
Sound transmission from a tapered fluid layer into a fast bottom
[AD-A050021] N78-21892
BOUNDARY VALUE PROBLEMS
Systems of generalized Abel integral equations with applications to simultaneous dual relations
[AD-A049446] N78-21844
Boundary-dependent stability criteria for difference approximations of hyperbolic problems, 1
[AD-A049501] N78-21846
Systems of generalized Abel integral equations
[AD-A050001] N78-21857
A road map of methods for approximating solutions of two-point boundary-values problems
[AD-A049971] N78-21858
BRAIN
Pupillometric signs of brain activation vary with level of cognitive processing
[AD-A050029] N78-21757
BRAZIL
Study of soft alkaline using LANDSAT images of pools and residue with an emphasis on radioactive materials — Brazil
[E78-10104] N78-21510
Remote sensing applied to geological mapping; comparative geomorphology and identification of mineral zones of zinc and lead in the region of Vazante, MG — Brazil
[E78-10108] N78-21514
BREADBOARD MODELS
Design, fabrication, and testing of a full-scale breadboard in nitrogen generator for fuel tank inerting application
[AD-A049459] N78-21097
BREATHING APPARATUS
Aircrew and passenger protective breathing equipment studies
[AD-A051002] N78-21768
BREMSSTRAHLUNG
The evaluation and energy propagation of relativistic electron-nucleus Bremsstrahlung and virtual photon spectra
N78-21895
BRITTLENESS
Erosion of brittle materials by solid particle impact
[AD-A050252] N78-21296
BROWNIAN MOVEMENTS
A satellite control problem
[AD-A049510] N78-21194
Light scattering and Brownian motion
N78-21912
BUILDINGS
Investigation of the properties of the combustion products generated by building fires
[PB-276549/3] N78-21244
BURNING RATE
Propellant burning rate and combustion uniformity identified by ultrasonic acoustic emissions
[AD-A049942] N78-21308

C

CABLES [ROPES]
Stored charge release in cables in low fluence X-ray environments
[AD-A050112] N78-21376
The time to failure of cables subjected to random loads
[AD-A049585] N78-21498
CALDERAS
Study of soft alkaline using LANDSAT images of pools and residue with an emphasis on radioactive materials — Brazil
[E78-10104] N78-21510
CALIBRATING
Calibration of an IRS based on flight data
N78-21076
Airflow and thrust calibration of an F100 engine, S/N P680059, at selected flight conditions
[NASA-TP-1069] N78-21112
A method of calibrating wind velocity sensors with a modified gas flow calibrator
[NASA-TM-78707] N78-21426
A small gas inlet system for orbital mass-spectrometer calibrations
[NASA-TP-1170] N78-21430
A feasibility study of ion implantation techniques for mass spectrometer calibration
[NASA-TP-1185] N78-21431
Real-time, intermediate-field astrometry
[AD-A048155] N78-22001
CALIFORNIA
Heat capacity mapping mission ground measurements — Dunnigan, California
[E78-10113] N78-21518
An integrated study of earth resources in the state of California using remote sensing techniques
[E78-10115] N78-21520
Water resources data for California, water year 1976. Volume 3: Southern central valley basins, and the great basin from Walker River to Truckee River
[PB-276354/8] N78-21586
Distributed technologies in California's energy future, volume 1
[LBL-6831-VOL-1] N78-21623
Geothermal environmental studies, Heber region, Imperial Valley, California. Environmental baseline data acquisition
[EPRI-ER-352] N78-21630
Results of reservoir evaluation tests, 1976 East Mesa Geothermal Field, California
[LBL-6369] N78-21631
Distributed technologies in California's energy future: A preliminary report, volume 2
[LBL-6831-VOL-2] N78-21635
California residential energy standards: Problems and recommendations relating to implementation, enforcement, design
[SAN/1178-1] N78-21640
CANADA
The radio climatology of Canada. Tropospheric refractivity atlas for Canada
[CRC-1315-E] N78-21689
CANARD CONFIGURATIONS
Subsonic longitudinal and lateral-directional static aerodynamic characteristics for a close-coupled wing-canard model in both swept back and swept forward configurations
[NASA-TM-74092] N78-21049
CAPACITORS
Measurement of the changes in dissipation factor and dielectric constant as a method of evaluating degradation in capacitor oils
[AD-A050004] N78-21380
CARBIDES
Composition of eta carbide in Hastelloy N after aging 10000 hr at 815 C
[ORNL-5340] N78-21283
CARBON
Ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas
[NASA-CR-156068] N78-21924
CARBON DIOXIDE
Advanced solid electrolyte cell for CO2 and H2O electrolysis — for extended duration manned spaceflights
[NASA-CR-152093] N78-21235
CALINE 2: An improved microscale model for the dispersion of air pollutants from a line source
[PB-275683/1] N78-21676
CARBON DIOXIDE LASERS
A preliminary study of aerosol initiated CO2 laser produced air sparks and their ability to guide electrical discharges
[AD-A050097] N78-21453
An investigation of laser interactions
[AD-A050049] N78-21460

CARBON MONOXIDE
A survey of carbon monoxide in Cygnus X
N78-21997

CARBON STEELS
Application of superplastic steels — thermomechanical forging of carbon steels
[AD-A049469] N78-21270
Code of practice for welding. Part 5: Welders' competence tests for manual oxy-acetylene, manual metal-arc, manual gas-shielded tungsten-arc, and manual gas-shielded metal-arc welding of mild steel [carbon steel] and medium high tensile steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-5-1976-REV-1]
N78-21467

CARBURIZING
A study of the effect of carbon upon the elevated temperature mechanical, fracture and static load crack extension behavior of austenitic stainless steel
N78-21255

CARCINOGENS
Investigations of the biological effects of radiation: A multi-discipline approach
[COO-2486-366] N78-21760

CARDIOLOGY
Microprocessor-based cardiopulmonary monitoring system
[NASA-CR-151688] N78-21752

CARGO AIRCRAFT
Aircraft cargo compartment fire test simulation program
[NASA-CR-151951] N78-21223

CASCADE FLOW
Hot cascade test results of cooled turbine blades and their application to actual engine conditions
N78-21125

CASCADE WIND TUNNELS
The execution of systematic measurements on plane cascades
[NASA-TM-75278] N78-21413

CASCADES
A new transient cascade facility for the measurement of heat transfer rates
N78-21149

CATHODES
Pitting in aluminum — copper cathode formation
[AD-A049854] N78-21274
Evaluation of lithium titanates as cathode materials
N78-21588

CAUCHY PROBLEM
Direct transformation of variational problems into Cauchy systems. 1: Scalar-quadratic case
[AD-A049526] N78-21847
Direct transformation of variational problems into cauchy systems. 2: Scalar-semi-quadratic case
[AD-A049527] N78-21848

CAVITATION CORROSION
Scaling of cavitation damage
[AD-A049766] N78-21419

CAVITATION FLOW
Scaling of cavitation damage
[AD-A049766] N78-21419

CAVITIES
Excitation of a wire in a rectangular cavity. Part 1: Theory
[AD-A050073] N78-21365
Excitation of a wire in a rectangular cavity. Part 2: Computer documentation
[AD-A050074] N78-21366

CENTAUR PROJECT
Boundary layer analysis of a Centaur standard shroud
[NASA-TM-78843] N78-21404

CENTRAL PROCESSING UNITS
Systems integration of marketable subsystems: A collection of progress reports
[NASA-CR-150587] N78-21594
Thermal radiation analysis system [TRASYS 2], programmer's manual
[NASA-CR-151686] N78-21792

CENTRIFUGAL COMPRESSORS
Test evaluation of stationary and rotating diffusers for a high pressure ratio radial compressor
[AD-A049856] N78-21474

CENTRIFUGAL PUMPS
Analytical models and experimental studies of centrifugal pump performance in two-phase flow. Key phase report
[EPRI-NP-170] N78-21477

CERAMIC COATINGS
Evaluation of a ceramic combustion chamber for a small gas turbine engine
N78-21145

CERAMICS
Development of SiAlON materials
[NASA-CR-135290] N78-21289
Erosion of brittle materials by solid particle impact
[AD-A050252] N78-21296
Development of a ceramic tube heat exchanger with relaxing joint
[FE-2356-06] N78-21423
Dynamic photoelastic and dynamic finite element analyses of dynamic tear test specimens
[AD-A049780] N78-21504

CHAD
LANCHAD: Remote sensing of the N'Djamena area and the Logone-Chari confluent
[NASA-TM-75087] N78-21570

CHALCOGENIDES
Photoemission studies of layered transition metal dichalcogenides
N78-21948

CHARACTERIZATION
A character formula for the discrete series of a semisimple lie group
N78-21886
Electroreflectance in semiconductors and its application as a method of materials characterization
N78-21950

CHARGE COUPLED DEVICES
Thin-film bucket brigade device charge-transfer efficiency improvements for display applications
[AD-A050475] N78-21387

CHARGE TRANSFER
Thin-film bucket brigade device charge-transfer efficiency improvements for display applications
[AD-A050475] N78-21387

CHARGED PARTICLES
Binding energy and effectiveness mass of charged particles trapped on surfaces
[AD-A049945] N78-21964

CHECKOUT
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10105] N78-21511
LANDSAT-C flight activation plan
[E78-10106] N78-21512

CHEMICAL ANALYSIS
Comparison of wet chemical and instrumental methods for measuring airborne sulfate
[PB-276620/2] N78-21248
Remote in-situ elemental analysis systems for underwater application — measuring pollutants in the chesapeake bay
N78-21546

CHEMICAL BONDS
Friction and metal transfer for single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1191] N78-21294

CHEMICAL COMPOSITION
Influence of metal variables on the structure and properties of heavy section ductile iron
N78-21253
Composition of eta carbide in Hastelloy N after aging 10000 hr at 815 C
[ORNL-5340] N78-21283

CHEMICAL FUELS
Chemicals from coal: USBM Synthoil
[FE-1534-49] N78-21320

CHEMICAL PROPERTIES
Chemical and physical properties of refined petroleum products
[PB-277100/4] N78-21312
Properties of new superconducting materials — niobium and germanium compounds
[AD-A050296] N78-21959

CHEMICAL REACTIONS
Calculated rate constants for the reaction ClO + O yields Cl + O2 between 220 and 1000 deg K — molecular trajectories and stratospheric ozone
[NASA-TM-78483] N78-21215
Inorganic halogenoxidizer research
[AD-A050133] N78-21238
High energy halogen chemistry — propellants and explosives
[AD-A049555] N78-21240
An evaluation of electrochemical concentration Cell [ECC] sonde measurements of atmospheric ozone
[NASA-CR-2973] N78-21429
Kinetics of model chemical reactions
N78-21894

CHEMISORPTION
Ultraviolet photoemission studies of formaldehyde and related molecules absorbed on Ru[110]
[AD-A049661] N78-21239
Prospects for studying gas chemisorption kinetics using current fluctuations
N78-21953
Chemisorption and reaction mechanisms on iron and iridium surfaces
N78-21955

CHESAPEAKE BAY [US]
Application of Remote Sensing to the Chesapeake Bay Region. Volume 2: Proceedings
[NASA-CP-6] N78-21526
The Chesapeake Bay: Our regional resource
N78-21527
The Chesapeake Bay Program: An opportunity to use an innovative monitoring technique
N78-21528
Activities of the US Geological Survey in Applications of Remote Sensing in the Chesapeake Bay Region
N78-21530
LANDSAT and other sensor data for land-use planning in the Baltimore area
N78-21532
Remote sensing, geology, and land use
N78-21533
The Chesapeake Bay: A challenge to the remote sensing community
N78-21535
On measuring the state of the bay
N78-21537
Use of remote sensing technology provided by the NASA/WFC Chesapeake Bay Ecological Program
N78-21538
Hydraulic model of the Chesapeake Bay
N78-21539
Remote sensing of water quality
N78-21541
Relationship of land use to water quality in the Chesapeake Bay region — water sampling and photomapping river basins
N78-21544
An overview of dredging operations in the Chesapeake Bay — environment effects and coastal ecology
N78-21545
Remote in-situ elemental analysis systems for underwater application — measuring pollutants in the chesapeake bay
N78-21546
Eutrophication in the Chesapeake Bay
N78-21551
Inferring nutrient loading of estuarine systems by remote sensing of aquatic vegetation
N78-21552
Contribution of remote sensing to understand the Bay as a system
N78-21553
Role of remote sensing in documenting living resources
N78-21554
Use of remote sensing in facility siting
N78-21555
Role of remote sensing in documenting land use as it affects the Bay and Bay use as it affects the land
N78-21556
Role of remote sensing in Bay measurements
N78-21557
Possible role of remote sensing for increasing public awareness of the Chesapeake Bay environment
N78-21558
NCSL task force findings on feasible state uses of LANDSAT
N78-21559
Progress toward a circulation atlas for application to coastal water siting problems
[VIMS-CONTRIB-823] N78-21560
Application of a computerized environmental information system to master and sector planning
N78-21561
A report on the Chesapeake Bay region NOWCASTING experiment
[PB-277102/0] N78-21732

CHLORINE OXIDES
Calculated rate constants for the reaction ClO + O yields Cl + O2 between 220 and 1000 deg K — molecular trajectories and stratospheric ozone
[NASA-TM-78483] N78-21215

CIRCUIT BOARDS
Quantification of printed circuit board [PCB] connector reliability
[AD-A049980] N78-21378

CIRCUIT RELIABILITY
Quantification of printed circuit board [PCB] connector reliability
[AD-A049980] N78-21378
High-reliability, low-cost integrated circuits
[AD-A049763] N78-21383

CIRCUITS
Use of Floyd's algorithm to find shortest restricted paths
[AD-A049467] N78-21797

CIRCULAR CYLINDERS
Transient analysis of a finite length cylindrical scatterer very near a perfectly conducting ground, part 2
[AD-A050144] N78-21343
Transverse oscillations of a circular cylinder in uniform flow, part 1
[AD-A049825] N78-21416

CITIES
Windmill power for city people
[PB-275658/3] N78-21654

CIVIL AVIATION
Accuracy considerations on new Microwave Landing Systems [MLS] from an operational point of view
N78-21081
Area navigation systems and procedures
N78-21091

CLADDING
Fabrication of stainless steel clad tubing — gas pressure bonding
[NASA-CP-135347] N78-21265

CLASSICAL MECHANICS
Semiclassical methods for nonseparable systems
[LBL-6662] N78-21903

CLASSIFICATIONS
Simulation studies on some nearest neighbor rules for statistical classification
[AD-A049548] N78-21877

CLEARANCES
Gas path sealing in turbine engines
[NASA-TM-73890] N78-21109

CLIMATOLOGY
Heat capacity mapping mission ground measurements --- Dunnigan, California
[E78-10113] N78-21518
Energy conservation via solar energy application to multi-family and commercial structures. Volume 2, part 2: Solar energy atlas for New York state
[PB-276130/2] N78-21618
The radio climatology of Canada. Tropospheric refractivity atlas for Canada
[CRC-1315-E] N78-21689
CLINICAL MEDICINE
Separation of lymphocytes by electrophoresis under terrestrial conditions and at zero gravity, phase 3
[NASA-CR-151702] N78-21753
CLOUDS
Anomalous infrared emission from condensing and cooling steam clouds
[AD-A050083] N78-21914
CMOS
High-reliability, low-cost integrated circuits
[AD-A049763] N78-21383
COAL
Chemicals from coal: USBM Synthoil
[FE-1534-49] N78-21320
COAL GASIFICATION
Low-Btu coal gasification
[ERHQ-0015] N78-21318
Investigation of converting the product of coal gasification to methane by the action of microorganisms, phase 1
[FE-2203-16] N78-21319
Environmental assessment of low/medium BTU gasification
[PB-276580/8] N78-21325
Gasification combined cycle test facility, Pekin, Illinois
[FE-2352-03] N78-21632
COAL UTILIZATION
Low-Btu coal gasification
[ERHQ-0015] N78-21318
Effluent characterization from a conical pressurized fluid bed
[NASA-TM-73897] N78-21596
COASTAL ECOLOGY
An overview of dredging operations in the Chesapeake Bay --- environment effects and coastal ecology
N78-21545
Coastal upwelling ecosystems analysis. Technical report 34: Physical and biological measurements, 29 July - 5 August 1973
[PB-276486/8] N78-21746
COASTAL PLAINS
Inventory of forest resources [including water] by multi-level sampling --- nine northern Virginia coastal plain counties
[E78-10118] N78-21522
COASTS
Coastal upwelling ecosystems analysis, data report 39. Joint 2: R/V Thomas G. Thompson cruise 108 leg 1, CTD measurements off the coast of Peru near Cabo Nazca, April - May 1976
[PB-276532/9] N78-21742
Coastal upwelling ecosystems analysis, data report 40. Joint 2: R/V Thomas G. Thompson cruise 108 legs 2 and 3, CTD measurements off the coast of Peru near Cabo Nazca, May - June 1976
[PB-276533/7] N78-21743
Coastal upwelling ecosystems analysis. Data report 41: Physical, chemical and biological observations from JOINT 2 R/V ALPHA HELIX, Leg O, 5-20 March 1976
[PB-276297/9] N78-21745
COATINGS
Antifouling activity of phytotoxic compounds and experimental polymeric algicides
[MRL-R-698] N78-21747
COBALT ALLOYS
Cobalt-base alloys for hot corrosion protective coatings
N78-21142
COCHLEA
Transmission of impulse noise to the inner ear in the guinea pig by the recording of the intracochlear pressure. Evaluation of phenomena leading to injuries
[ISL-R-103/77] N78-21749
CODING
Performance measurements of the CVSD speech coding algorithm
[AD-A050163] N78-21362
COEFFICIENT OF FRICTION
Friction and metal transfer for single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1191] N78-21294
COGNITION
Pupillometric signs of brain activation vary with level of cognitive processing
[AD-A050029] N78-21757
COLD PRESSING
Development of SiAlON materials
[NASA-CR-135290] N78-21289
COLD WEATHER TESTS
Helmet cold conditioning: Correlation of structural temperatures in actual and simulated cold environments
[AD-A050033] N78-21769
COLLISION AVOIDANCE
Investigation to support phase 1 of the USAF midair prevention systems program [MAPS]
[AD-A049743] N78-21066
Bearing study program --- bearing measurement subsystem for SECANT Collision Avoidance System
[AD-A049767] N78-21068
Collision detection and avoidance in computer controlled manipulators
N78-21766
COLLISION PARAMETERS
Kinetics of model chemical reactions
N78-21894
COLLISIONLESS PLASMAS
Numerical simulations of collisionless drift instabilities for low-density plasmas
[PPPL-1382] N78-21930
COLLOCATION
Unsteady two dimensional airloads acting on oscillating thin airfoils in subsonic ventilated wind tunnels
[NASA-CR-2967] N78-21059
COLLOIDS
Theory of large agglomerates in magnetic colloids
N78-21921
COLORADO
Annotated bibliography of natural resource information: Northwestern Colorado
[PB-275997/5] N78-21579
COMBUSTION
Experiments related to external burning for propulsion
[AD-A047623] N78-21241
Modeling of convective mode combustion through granulated propellant to predict transition to detonation
[AD-A049499] N78-21302
A reacting turbulent boundary layer approach to solid propellant erosive burning
[AD-A049537] N78-21307
Propellant burning rate and combustion uniformity identified by ultrasonic acoustic emissions
[AD-A049942] N78-21308
Catalyzed combustion in a flat plate boundary layer. 1: Experimental measurements and comparison with numerical calculations
[LBL-6841] N78-21636
COMBUSTION CHAMBERS
A review of techniques for the thermal protection of the walls of the combustion chamber and reheating ducts of turboreactors
N78-21134
Practical solutions to the cooling of combustors operating at high temperatures
N78-21135
High temperature H2-Air variable geometry combustor and turbine: Test facility and measurements
N78-21137
Evaluation of a ceramic combustion chamber for a small gas turbine engine
N78-21145
A comparison between predicted and measured species concentrations and velocities in a research combustor
N78-21158
Liquid rocket engine self-cooled combustion chambers
[NASA-SP-8124] N78-21211
High Temperature Turbine Technology Program. Phase 1: Program and system definition. Topical report: Low BTU gas combustor technology development plan
[FE-2290-26] N78-21480
Effluent characterization from a conical pressurized fluid bed
[NASA-TM-73897] N78-21596
COMBUSTION PHYSICS
Combustion properties of high density fuels --- liquid rocket propellant combustion simulation using pneumatic equipment
[AD-A050051] N78-21310
COMBUSTION PRODUCTS
Time-dependent fire behavior of aircraft cabin materials
[AD-A050923] N78-21234
Investigation of the properties of the combustion products generated by building fires
[PB-276549/3] N78-21244
Preliminary environmental assessment of combustion modification techniques. Volume 1: Summary
[PB-276680/6] N78-21677
Preliminary environmental assessment of combustion modification techniques. Volume 2: Technical results
[PB-276681/4] N78-21678
COMBUSTION STABILITY
Low frequency combustion instability in augmentors
N78-21138
COMBUSTION TEMPERATURE
Temperature profile of graphite surface burning in a stream of oxygen
[NASA-TM-75271] N78-21232
COMETS
Laboratory simulation of infrared astrophysical features --- silicate mixtures with emission spectra matching those of comets
N78-21998
COMMAND AND CONTROL
Large active retrodirective arrays for space applications
[NASA-CR-156163] N78-21333
COMMERCIAL ENERGY
Fuel and energy price forecasts: Quantities and long-term marginal prices, volume 1
[EPRI-EA-433-VOL-1] N78-21637
COMMUNICATING
An evaluation of data information transfer requirements for the future DCS
[AD-A049464] N78-21780
COMMUNICATION NETWORKS
Traffic flow, performance and interface characterization study for Europe
[AD-A049462] N78-21353
Studies for the development of a unified node employing dynamic channel location
[AD-A049619] N78-21356
COMMUNICATIONS TECHNOLOGY SATELLITE
A depolarization and attenuation experiment using the COMSTAR and CTS satellites
[NASA-CR-156730] N78-21336
COMMUTATORS
On minimum energy control of commutative bilinear systems
[AD-A049500] N78-21821
COMPENSATORS
Design of a compensation for an ARMA model of a discrete time system
[NASA-CR-156097] N78-21838
COMPOSITE MATERIALS
New materials for high temperature turbines: ONERA's DS composites confronted with the blade problems
N78-21139
Complex loading of a composite material with a plastic matrix by torsion and tension
N78-21222
Study of environmental effects on thermomechanical behavior of resin-base composites
[AD-A049538] N78-21225
Certain results of determining the temperature dependences of the thermophysical characteristics of composite polymers
N78-21292
Asymptotically derived cylindrical shell theories with application to anisotropic composite materials
N78-21488
A biaxial method for inplane shear testing --- shear strain in composite materials
[NASA-TM-74070] N78-21489
COMPOSITE PROPELLANTS
Audible and ultrasonic acoustic emissions from composite solid propellants
[AD-A049517] N78-21304
COMPRESSOR ROTORS
Heat transfer from turbine and compressor discs
N78-21133
COMPTON EFFECT
Improved calculations of X-ray and inelastic electron scattering Compton profiles
[AD-A049513] N78-21960
COMPUTATION
Scientific calculating system with a number-oriented microprocessor sequenced by a single component microcomputer
[LA-UR-2383] N78-21789
Improved calculations of X-ray and inelastic electron scattering Compton profiles
[AD-A049513] N78-21960
COMPUTER ASSISTED INSTRUCTION
Evaluation of the transfer and cost effectiveness of a complex computer-assisted flight procedure trainer
[AD-A050413] N78-21764
A new approach to computer aided transient analysis of stiff linear networks
N78-21818
COMPUTER DESIGN
Summer faculty systems design program. Integrating wind tunnels and computers. Volume 2: Details of summer design study USAF/OSR/ASEE
[AD-A050071] N78-21167
COMPUTER GRAPHICS
Notes on data file exchange between the NRL TIASC and the DTNSRDC CDC-6616700
[AD-A049797] N78-21981
COMPUTER NETWORKS
Notes on data file exchange between the NRL TIASC and the DTNSRDC CDC-6616700
[AD-A049797] N78-21981
Decision making with interactive access to integrated administrative and technological data bases. An illustrated conceptual overview --- energy storage
[UCRL-80353] N78-21986

COMPUTER PROGRAMMING
Collision detection and avoidance in computer controlled manipulators
N78-21766
Proceedings of the 1st Annual Rocky Mountain Symposium on Microcomputers: Systems, Software, Architecture
[AD-A049559] N78-21786
Multicriteria integer zero-one programming: A tree-search type algorithm
[AD-A050244] N78-21807
Synthesis: Dreams yield programs
[AD-A049761] N78-21814
Performances assurance and data integrity practices
[PB-276400/9] N78-21819

COMPUTER PROGRAMS
A three-dimensional potential-flow program with a geometry package for input data generation
[NASA-CR-145311] N78-21047
A vectorization of the Jameson-Caughey NYU transonic swept-wing computer program FLO-22-V1 for the STAR-100 computer
[NASA-TM-78665] N78-21050
Summer faculty systems design program. Integrating wind tunnels and computers. Volume 1: Executive summary. USAF/OSR/ASEE
[AD-A050072] N78-21171
In situ ply strength: An initial assessment --- using laminate fracture data and a least squares method
[NASA-TM-73771] N78-21220
Computation of groundwave attenuation over irregular and inhomogeneous ground at low and medium frequencies
[BBC-RD-1978/7] N78-21332
Experimental validation of the Antenna Pattern Distortion Computer Program, VHF antenna
[AD-A049740] N78-21345
Evaluation of two computer programs for modeling electromagnetic interactions with surfaces
[UCRL-52321] N78-21368
NASA charging analyzer program: A computer tool that can evaluate electrostatic contamination
[NASA-TM-73889] N78-21372
Distributed sensor networks
[AD-A050160] N78-21576
Analyses of methods for the determination of water availability for energy development
[FEA/G-77/059] N78-21580
Methods for estimating areal precipitation in mountainous areas
[PB-276140/1] N78-21731
L-STAR: An interactive, symbolic implementation system
[AD-A050119] N78-21785
Completing the requirements set as a means towards better design frameworks: A follow-up exercise in software architectural design
[AD-A049782] N78-21787
FLOWNET: A computer program for calculating secondary flow conditions in a network of turbomachinery
[NASA-TM-73774] N78-21791
Thermal radiation analysis system [TRASYS 2], programmer's manual
[NASA-CR-151686] N78-21792
SEMANOL [76] interpreter documentation, volume 4
[AD-A049475] N78-21796
A computer program for solving learning curve problems
[AD-A049917] N78-21812
MINKIT: An optimization system
[ANL-AMD-TM-305] N78-21817
CMS histogram, density estimation and probability plotting routines, with an application to the analysis of the output of assimulation of a correlated queue
[AD-A050213] N78-21827

COMPUTER SYSTEMS DESIGN
Computer family architecture selection committee. Volume 6: Life cycle cost models
[AD-A049487] N78-21776
Computer family architecture selection committee
[AD-A049466] N78-21781
Performances assurance and data integrity practices
[PB-276400/9] N78-21819

COMPUTER SYSTEMS PROGRAMS
Trends of future turbine life prediction: Time phase automated analysis and test verification
N78-21143
The N-BOD2 user's and programmer's manual
[NASA-TP-1145] N78-21200
Software engineering. Volume 1: Its development and standards
[AD-A049869] N78-21813

COMPUTER TECHNIQUES
Application of a computerized environmental information system to master and sector planning
N78-21561
Computer Family Architecture Selection Committee. Volume 3: Evaluation of computer architecture via test programs
[AD-A049482] N78-21773
Computer Family Architecture Selection Committee. Volume 4: Architectural research facility ISP description, simulations, data collection
[AD-A049483] N78-21774
Computer Family Architecture Selection Committee. Volume 5: Procedure for and results of the evaluations of software bases of the candidate architectures for the military computer family
[AD-A049484] N78-21775
Executive aids for crisis management
[AD-A049954] N78-21975

COMPUTERIZED SIMULATION
Digital computer simulation of the mechanical and thermal response of complex hydraulic systems
N78-21396
Solar space heating systems using annual heat storage
[COO/2939-1] N78-21645
A study of the characteristics of the data systems test kinematic fields
[AD-A050060] N78-21721
Motivation and intensionality in a computer simulation model
N78-21790
Automated image enhancement techniques for second generation FLIR
[AD-A049564] N78-21913
Simulation model for resource policy evaluation
[PB-275938/9] N78-21990

COMPUTERS
Translations on USSR science and technology: Physical sciences and technology, no. 33
[JPRS-70946] N78-21183
IEMCAP implementation study. Volume 2: Annex electromagnetic compatibility handbook for system development and procurement
[AD-A049738] N78-21357
LAPAC: A computer package for solving the Laplace transform
N78-21837

CONCENTRATION [COMPOSITION]
An evaluation of electrochemical concentration Cell [ECC] sonde measurements of atmospheric ozone
[NASA-CR-2973] N78-21429

CONDENSING
Anomalous infrared emission from condensing and cooling steam clouds
[AD-A050083] N78-21914

CONDUCTIVE HEAT TRANSFER
ORINC: A one-dimensional implicit approach to the inverse heat conduction problem
[ORNL-NUREG-23] N78-21422

CONFERENCES
AGARD highlights --- flight mechanics activities
[AGARD-HIGHLIGHTS-78/1] N78-21046
High temperature problems in gas turbine engines
[AGARD-CP-229] N78-21118
Utilization of lunar materials and expertise for large scale operations in space: Abstracts --- lunar bases and space industrialization
[NASA-CR-156167] N78-21180
Application of Remote Sensing to the Chesapeake Bay Region. Volume 2: Proceedings
[NASA-CP-6] N78-21526
Active Microwave Users Workshop Report
[NASA-CP-2030] N78-21562
Small Power Systems Solar Electric Workshop Proceedings. Volume 1: Executive report. Volume 2: Invited papers
[NASA-CR-156165] N78-21599
Proceedings of the Energy Research and Development Administration Conference on Cogeneration and Integrated Energy/Utility Systems
[CONF-770632] N78-21644
International Conference on Oxidants, 1976: Analysis of Evidence and Viewpoints. Part 1: Definition of key issues
[PB-276768/9] N78-21679
Incentives for the generation, dissemination and use of scientific and technical information
[PB-276180/7] N78-21985
Transcript of National Commission on New Technological uses of copyrighted works
[PB-275786/2] N78-21987
Conference report to the National Science Foundation on the NFAIS/ASIDIC/EUSIDIC/ICSUAB Meeting on Bibliographic Control
[PB-275791/2] N78-21988

CONFORMAL MAPPING
Extremal problems in quasiconformal mappings with side conditions
N78-21831

CONGRESSIONAL REPORTS
Use of solar energy in Federal Building
[GPO-94-365] N78-21610
Incentives for developing new energy sources
[GPO-93-810] N78-21613
Airport and aircraft noise reduction
[GPO-91-591] N78-21891

CONICAL BODIES
Laminar boundary layer stability measurements at Mach 7 including wall temperature effects --- conical bodies
[AD-A049535] N78-21415

CONSOLES
Orbiter S-band FM system console test procedure
[NASA-CR-151694] N78-21338

CONSTANTS
Calculated rate constants for the reaction ClO + O yields Cl + O2 between 220 and 1000 deg K --- molecular trajectories and stratospheric ozone
[NASA-TM-78483] N78-21215

CONSTRAINTS
A further investigation of efficient heuristic procedures for integer linear programming with an interior
[AD-A049593] N78-21804
The unitarity constraint on the three-body final states
N78-21896

CONSTRUCTION
Materials for high-temperature hydrogen-fluorine environments
[Y/DA-7477] N78-21217

CONTINUOUS WAVE LASERS
Optically pumped mercury lasers for ring laser gyroscope applications
[AD-A049540] N78-21455

CONTINUUM FLOW
Heat transfer in continuum and rarefied gases
N78-21399

CONTINUUM MECHANICS
An applied overview of moving boundary problems
[AD-A049695] N78-21962

CONTRACT MANAGEMENT
Federal agencies should be given multiyear contracting authority for supplies and services
[PB-276028/8] N78-21978

CONTROL
System optimization by periodic control
[AD-A049522] N78-21162

CONTROL DATA [COMPUTERS]
A computerized log for Systems and Cost Analysis Division Cost Estimate Control Data Center [CECDC] validation activity
[AD-A049976] N78-21984

CONTROL SIMULATION
Results from flight and simulator studies of a Mach 3 cruise longitudinal autopilot
[NASA-TP-1180] N78-21160

CONTROL THEORY
Optimal control theory [OWEM] applied to a helicopter in the hover and approach phase
[NASA-CR-152135] N78-21161
On minimum energy control of commutative bilinear systems
[AD-A049500] N78-21821
A double integral quadratic cost problem with application to feedback stabilization
[AD-A049533] N78-21822
Multicriteria optimization with uncertainty in the dynamics
[AD-A049541] N78-21830
A modified quadratic cost problem and feedback stabilization of linear discrete time systems
[AD-A049519] N78-21883

CONTROLLABILITY
Global controllability for a class of bilinear systems
[AD-A049518] N78-21882

CONTROLLED FUSION
Four Workshops in Alternate Concepts in Controlled Fusion. Part A: Executive summaries. Part B: Extended summaries. Part C: CTR using the p-B-11 reaction
[EPRI-ER-429-SR-PT-A] N78-21927

CONVECTION
Investigations of the local heat transfer coefficient of a convection cooled rotor blade
N78-21126
Higher order effects, stability and transition in vertical natural convection flows
N78-21394

CONVECTION CLOUDS
The modification and application of Kuo's parameterization of cumulus convection in middle latitudes
[NASA-CR-2998] N78-21717

CONVECTIVE FLOW
Mean velocity, turbulence intensity and turbulence convection velocity measurements for a convergent nozzle in a free jet wind tunnel
[NASA-CR-2949] N78-21058

CONVECTIVE HEAT TRANSFER
Studies on methods of reducing heat losses from flat plate solar collectors, phase 2
[COO/2597-3] N78-21624

CONVERGENCE
Convergence of weighted sums of random elements and statistical applications
N78-21872

CONVERGENT NOZZLES
Mean velocity, turbulence intensity and turbulence convection velocity measurements for a convergent nozzle in a free jet wind tunnel
[NASA-CR-2949] N78-21058

COOLANTS
The influence of coolant turbulence intensity of film cooling effectiveness
N78-21136

Cryogenic-coolant He-4-superconductor interaction
[NASA-CR-2963] N78-21406
COOLING
Progress in advanced high temperature turbine materials, coatings, and technology
N78-21122
Anomalous infrared emission from condensing and cooling steam clouds
[AD-A050083] N78-21914
COOLING SYSTEMS
High temperature problems in gas turbine engines
[AGARD-CP-229] N78-21118
Heat transfer characteristics of the closed thermosyphon system
N78-21132
Measuring techniques in high temperature turbines
N78-21151
Flow and heat transfer in rotating coolant channels
N78-21156
Space shuttle L-tube radiator testing
[NASA-CR-151695] N78-21196
Liquid rocket engine self-cooled combustion chambers
[NASA-SP-8124] N78-21211
Modeling of Rankine cycle/vapor compression cycle cooling systems for solar energy applications
N78-21587
Central Data Processing System [CDPS] user's manual: Solar heating and cooling program
[NASA-CR-150580] N78-21595
Installation energy control system analysis program
[AD-A049488] N78-21615
COPPER
Investigation of the surface roughness of evaporated copper films by optical scattering
N78-21252
Pitting in aluminum — copper cathode formation
[AD-A049854] N78-21274
Wear of single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1198] N78-21295
COPPER ALLOYS
Theory of amorphous CuNi alloys
N78-21250
COPYRIGHTS
Transcript of National Commission on New Technological uses of copyrighted works
[PB-275786/2] N78-21987
CORIOLIS EFFECT
Numerical investigation of the effect of a Coriolis force on the stability of plane Poiseuille flow
[AD-A049521] N78-21414
CORNER FLOW
Flow field visualization about external axial corners
[NASA-TM-78682] N78-21056
CORROSION RESISTANCE
Cobalt-base alloys for hot corrosion protective coatings
N78-21142
Characterization of wear debris generated in accelerated rolling-element fatigue tests
[NASA-TP-1203] N78-21470
CORROSION TESTS
Effluent characterization from a conical pressurized fluid bed
[NASA-TM-73897] N78-21596
COSINE SERIES
Analytical determination of the Burmester lines for cylindric-cylindric cranks
N78-21465
COSMIC RAYS
Gamma-ray astronomy and the origin of cosmic rays
[NASA-TM-79535] N78-22017
COSMONAUTS
Tsiolkovsky's Ideas on Cosmonautic Problems
[NASA-TT-F-16118] N78-21177
Cosmonaut work capacity in flight
N78-21762
COSMOS SATELLITES
Translations on USSR science and technology: Physical sciences and technology, no. 33
[JPRS-70946] N78-21183
A runaway satellite is going to crash 20 April — Cosmos 849 satellite
N78-21184
COSMOS 936 SATELLITE
Biological satellite Kosmos-936
[NASA-TM-75097] N78-21192
COST ANALYSIS
A life cycle cost study of contractor versus organic support of aircraft programs
[AD-A049438] N78-21045
Fiber Optics Cost Analysis Program [FOCAP]
[AD-A049859] N78-21105
Fuel and energy price forecasts: Quantities and long-term marginal prices, volume 1
[EPRI-EA-433-VOL-1] N78-21637
A computerized log for Systems and Cost Analysis Division Cost Estimate Control Data Center [CECDC] validation activity
[AD-A049976] N78-21984
The cost of water supply and water utility management, volume 1
[PB-276639/2] N78-21992
The cost of water supply and water utility management, volume 2
[PB-276640] N78-21993
COST EFFECTIVENESS
A review of methodologies and concepts to measure and evaluate aircraft survivability/vulnerability
[AD-A050152] N78-21099
Cost-effectiveness of flight simulators for military training. Volume 2: Estimating costs of training in simulators and aircraft
[AD-A049979] N78-21168
Computer family architecture selection committee. Volume 6: Life cycle cost models
[AD-A049487] N78-21776
COST ESTIMATES
A range of cost measuring risk and uncertainty in major programs: An aid to decision making — for federal funding
[PB-276384/5] N78-21979
COST INCENTIVES
Incentives for developing new energy sources
[GPO-93-810] N78-21613
COUNTERMEASURES
Satellite surveillance avoidance optimization aid — for naval operations
[AD-A049561] N78-21195
COUPLING CIRCUITS
A study of the waveguide mode excitation and propagation in a parallel plate transmission line
[AD-A050118] N78-21360
COVARIANCE
The calculation of RMS values of deviations of aircraft controlled to fly along a desired flight path
N78-21084
Solutions to the Kalman filter wordlength problem: Square root and U-D covariance factorizations
[AD-A049704] N78-21854
CRACK INITIATION
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 1: Program summary and data analysis
[NASA-CR-135369] N78-21493
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 2: Crack opening displacement and stress-strain data
[NASA-CR-135370] N78-21494
CRACK PROPAGATION
A fracture mechanics analysis of the kinetics of stress-corrosion crack growth in a high-strength 12Ni-5Cr-3Mo maraging steel
N78-21256
Study of surface fatigue wear by exoelectron emission
[AD-A049927] N78-21476
Environmental effects on crack growth in flight-simulation tests on 2024-T3 and 7075-T6 material
[NLR-TR-76104-U] N78-21492
Dynamic photoelastic and dynamic finite element analyses of dynamic tear test specimens
[AD-A049780] N78-21504
CRACKING [FRACTURING]
Mixed-mode fracture of graphite/epoxy composites
[AD-A049528] N78-21224
Influence of fretting on flexural fatigue of 304 stainless steel and mild steel
[NASA-TP-1193] N78-21269
Nondestructive evaluation of metal fatigue
[AD-A049539] N78-21277
Systems of generalized Abel integral equations with applications to simultaneous dual relations
[AD-A049446] N78-21844
CRASH LANDING
Aircraft accident report: Southern Airways Inc., DC-9-31, N1335U, New Hope, Georgia, April 4, 1977
[NTSB-AAR-78-3] N78-21064
CRATERS
Standard techniques for presentation and analysis of crater size-frequency data
[NASA-TM-79730] N78-22006
CREEP RUPTURE STRENGTH
Basic creep-rupture testing at 1100 deg F [593 deg C] of type 304 stainless steel for uniaxially loaded specimens with stress and strain gradients
[WARD-HT-3045-26] N78-21284
CRITICAL PATH METHOD
Executive aids for crisis management
[AD-A049954] N78-21975
CROP GROWTH
Estimated winter wheat yield from crop growth predicted by LANDSAT — Kansas
[E78-10112] N78-21517
CROSS FLOW
Experimental investigation of effect of jet decay rate on jet-induced pressures on a flat plate
[NASA-CR-2979] N78-21096
CROSSED FIELD AMPLIFIERS
Analysis of distributed-emission crossed-field amplifiers
[AD-A050185] N78-21391
CRUDE OIL
Chemical and physical properties of refined petroleum products
[PB-277100/4] N78-21312
Chemicals from coal: USBM Synthoil
[FE-1534-49] N78-21320
Alaskan oil transportation issues
[PB-276449/6] N78-21661
Use of the method of one-dimensional nonlinear transformations to forecast the natural model of an oil stratum
N78-21693
CRUSTAL FRACTURES
A geophysical investigation of the oceanographer fracture zone and the mid-Atlantic ridge in the vicinity of 35 deg north
N78-21683
CRYOGENIC EQUIPMENT
Theoretical contamination of cryogenic satellite telescopes
[NASA-TP-1177] N78-21193
Cryogenically-cooled microwave acoustic relay devices
[AD-A049765] N78-21382
CRYOGENIC FLUIDS
Cryogenic-coolant He-4-superconductor interaction
[NASA-CR-2963] N78-21406
CRYOGENICS
Comparison of reusable insulation systems for cryogenically-tanked earth-based space vehicles
[NASA-TM-73668] N78-21190
CRYSTAL GROWTH
Preparation of rare earth doped laser materials
[AD-A049697] N78-21454
CRYSTAL STRUCTURE
Properties of new superconducting materials — niobium and germanium compounds
[AD-A050296] N78-21959
CRYSTALLIZATION
Structure of deformed silicon and implications for low cost solar cells
[NASA-CR-156166] N78-21600
Novel silicon crystals and method for their preparation
[NASA-TM-75195] N78-21957
CULTIVATION
Germination of pine seed in weightlessness [investigation in Kosmos 782]
[NASA-TM-75281] N78-21172
CUMULUS CLOUDS
Characteristic size spectra of cumulus fields observed from satellites
[AD-A049936] N78-21724
CURRENT DISTRIBUTION
Current pulse generator with amplitude of 1,000,000 A and stability of plus or minus .001 at a repetition rate of two Hz
[AD-A049390] N78-21390
CURVE FITTING
An efficient algorithm for choosing the degree of a polynomial to approximate discrete nonoscillatory data
[NASA-TM-72854] N78-21839
On a measure of lack of fit in time series models
[AD-A049397] N78-21860
CURVES [GEOMETRY]
The Landau problem for motions on curves
[AD-A049492] N78-21828
CYCLES
The 5200 cycle test of an 8-cm diameter Hg ion thruster
[NASA-TM-78860] N78-21208
Heat transfer research and power cycle transient modeling
[COO-2641-4] N78-21424
CYCLOTRONS
Studies of parametric decay instabilities in magneto plasmas
[AD-A049547] N78-21925
CYGNUS CONSTELLATION
A survey of carbon monoxide in Cygnus X
N78-21997
CYLINDRICAL BODIES
Transient analysis of a finite length cylindrical scatterer very near a perfectly conducting ground, part 1
[AD-A050143] N78-21342

D

DAMPING
Dynamic response of linear damped continuous structural members
N78-21485
DATA ACQUISITION
Anisothermal oxidation of titanium and its alloy
[AD-A050053] N78-21281
Laboratory automatic data acquisition system
[BDX-613-1566] N78-21435
HCMM satellite to take earth's temperature
[NASA-NEWS-RELEASE-78-60] N78-21507
Acoustic remote probing of the environment — atmospheric and underwater acoustic data acquisition
N78-21542
Regional energetic coupling of man and his environment: Data requirements — regional planning and ecosystems
N78-21543
Possible role of remote sensing for increasing public awareness of the Chesapeake Bay environment
N78-21558

Applications of active microwave imagery
N78-21564
System design package for solar heating and cooling site data acquisition subsystem
[NASA-CR-150606] N78-21593
Systems integration of marketable subsystems: A collection of progress reports
[NASA-CR-150587] N78-21594
Geothermal environmental studies, Heber region, Imperial Valley, California. Environmental baseline data acquisition
[EPRI-ER-352] N78-21630

DATA BASES
Decision making with interactive access to integrated administrative and technological data bases. An illustrated conceptual overview --- energy storage
[UCRL-80353] N78-21986
Conference report to the National Science Foundation on the NFAIS/ASIDIC/EUSIDIC/ICSUAB Meeting on Bibliographic Control
[PB-275791/2] N78-21988

DATA CORRELATION
Correlation of laser velocimeter measurements over a wing with results of two prediction techniques --- in the Langley V/STOL tunnel
[NASA-TP-1168] N78-21410

DATA LINKS
Synthesis and analysis of precise spaceborne laser ranging systems, volume 1 --- link analysis
[NASA-CR-156727] N78-21442
Synthesis and analysis of precise spaceborne laser ranging systems, volume 2 --- Spacelab payload
[NASA-CR-156728] N78-21443

DATA MANAGEMENT
An evaluation of data information transfer requirements for the future DCS
[AD-A049464] N78-21780
Completing the requirements set as a means towards better design frameworks: A follow-up exercise in software architectural design
[AD-A049782] N78-21787
Continued implementation and testing of a Neighborhood Office Center [NOC] and integration of the NOC with an administrative correspondence management information system
[NASA-CR-156150] N78-21970

DATA PROCESSING
Synthetic Aperture Radar [SAR] data processing
N78-21567
Central Data Processing System [CDPS] user's manual: Solar heating and cooling program
[NASA-CR-150580] N78-21595
A note on the use of local MIN and MAX operations in digital picture processing
[AD-A049589] N78-21802
LAPAC: A computer package for solving the Laplace transform
N78-21837
Development and application of data processing and pattern recognition methods
[AD-A049846] N78-21982
Standard techniques for presentation and analysis of crater size-frequency data
[NASA-TM-79730] N78-22006

DATA REDUCTION
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 1: Program summary and data analysis
[NASA-CR-135369] N78-21493
Use of satellite images in the evaluation of farmlands --- in Mexico
[NASA-TM-75088] N78-21575
Real-time, intermediate-field astrometry
[AD-A048155] N78-22001

DATA TRANSMISSION
Traffic flow, performance and interface characterization study for Europe
[AD-A049462] N78-21353
An evaluation of data information transfer requirements for the future DCS
[AD-A049464] N78-21780
Notes on data file exchange between the NRL TIASC and the DTNSRDC CDC-6616700
[AD-A049797] N78-21981

DC 9 AIRCRAFT
Aircraft accident report: Southern Airways Inc., DC-9-31, N1335U, New Hope, Georgia, April 4, 1977
[NTSB-AAR-78-3] N78-21064

DEATH VALLEY (CA)
Geologic application of thermal inertia imaging using HCMM data --- Death Valley, California
[E78-10119] N78-21523

DECAY RATES
Experimental investigation of effect of jet decay rate on jet-induced pressures on a flat plate
[NASA-CR-2979] N78-21096

DECISION MAKING
Thermal discharges and their role in pending power plant regulatory decisions
N78-21547
Morphology of design of aerospace systems with inclusion of human factors
[AD-A049999] N78-21973
Operational decision aids: The application of nomography and uncertainty analysis to decision-aiding systems
[AD-A049545] N78-21974
Executive aids for crisis management
[AD-A049954] N78-21975
A range of cost measuring risk and uncertainty in major programs: An aid to decision making --- for federal funding
[PB-276384/5] N78-21979
Decision making with interactive access to integrated administrative and technological data bases. An illustrated conceptual overview --- energy storage
[UCRL-80353] N78-21986

DECOMPOSITION
Mechanism of the decomposition of ethylene at low pressure on the surface of rhenium ribbon at high temperature, 2
[BNWL-TR-254] N78-21246

DEFLAGRATION
Initiation mechanisms of solid rocket propellant detonation
[AD-A049531] N78-21305

DEFLECTION
Experiments on viscoplastic response of circular plates to impulsive loading
[AD-A049866] N78-21502

DEFORMATION
Structure and deformation characteristics of rheocast metals --- tin and aluminum alloys
[AD-A049975] N78-21279

DEGRADATION
Measurement of the changes in dissipation factor and dielectric constant as a method of evaluating degradation in capacitor oils
[AD-A050004] N78-21380

DELTA MODULATION
Multichannel still-picture transmission system: TDM transmission of delta-M sounds with still-picture in television channel
[NHK-LABS-NOTE-214] N78-21330

DEMAND [ECONOMICS]
Energy supply and environmental impacts: Conventional energy sources
[PB-276410/8] N78-21669

DEPOLARIZATION
A depolarization and attenuation experiment using the COMSTAR and CTS satellites
[NASA-CR-156730] N78-21336

DESALINIZATION
The application of wind energy systems to desalination
[PB-276174/0] N78-21620

DETONATION
Initiation mechanisms of solid rocket propellant detonation
[AD-A049531] N78-21305

DETONATION WAVES
Experimental study of the initiation mechanism of laser supported absorption waves
[AD-A050054] N78-21461

DIAMINES
Torsional pendulum study on several epoxy/diamine polymers
[AD-A050478] N78-21299

DIATOMIC MOLECULES
Study of diatomic molecules. 2: Intensities --- optical emission spectroscopy of ScO
[NASA-TM-75290] N78-21900

DIELECTRIC PROPERTIES
Measurement of the changes in dissipation factor and dielectric constant as a method of evaluating degradation in capacitor oils
[AD-A050004] N78-21380

DIELECTRICS
Analysis of thin-wire antennas in the presence of a dielectric and/or ferrite inhomogeneity
[AD-A049455] N78-21350

DIESEL ENGINES
Lightweight, low compression aircraft diesel engine --- converting a spark ignition engine to the diesel cycle
[NASA-CR-135300] N78-21471
Review of diesel combustion models for NOx and smoke emissions
[PB-276350/6] N78-21681

DIESEL FUELS
Time- and space-resolved species determination in diesel combustion using continuous flow gas sampling
N78-21227
Diesel fuel oils, 1977
[BERC/PPS-77/5] N78-21324

DIFFERENCE EQUATIONS
A Liapunov functional for a matrix neutral difference-differential equation with one display
[AD-A049868] N78-21859

DIFFERENTIAL EQUATIONS
Stability of an infinite system of differential equations
N78-21833
A road map of methods for approximating solutions of two-point boundary-values problems
[AD-A049971] N78-21858
A Liapunov functional for a matrix neutral difference-differential equation with one display
[AD-A049868] N78-21859
The stability of second order quadratic differential equations
[AD-A049771] N78-21865
Decomposition theorems for differential forms on Hilbert spaces
N78-21885

DIFFUSERS
Test evaluation of stationary and rotating diffusers for a high pressure ratio radial compressor
[AD-A049856] N78-21474

DIFFUSION
Shear dispersion in time-varying flows
[PB-277103/8] N78-21421

DIFFUSION COEFFICIENT
Variation of interdiffusion coefficient and ratio of intrinsic diffusion coefficients with composition in the NiAl [delta] phase of the Al-Ni system
N78-21257
Empirical determination of vertical diffusion coefficients for Los Angeles
[PB-275756/5] N78-21712

DIGITAL COMPUTERS
The N-BOD2 user's and programmer's manual
[NASA-TP-1145] N78-21200
Digital computer simulation of the mechanical and thermal response of complex hydraulic systems
N78-21396
Multivariable computer control of a gas metal arc welding process
N78-21466
Computer family architecture selection committee. Volume 6: Life cycle cost models
[AD-A049487] N78-21776
Computer family architecture selection committee. Volume 8: CFA final selection
[AD-A049485] N78-21777
Computer family architecture selection committee. Volume 9: A consideration of issues in the selection of a computer family architecture
[AD-A049486] N78-21778
Computer family architecture selection committee. Volume 2: Selection of candidate architectures and initial screening
[AD-A049457] N78-21779
Computer family architecture selection committee
[AD-A049466] N78-21781
Computer family architecture selection committee. Volume 1: Introduction
[AD-A049468] N78-21782
A control system for depicting information from computer on an electroluminophoric plate
[AD-A049394] N78-21788

DIGITAL DATA
The Chesapeake Bay: A challenge to the remote sensing community
N78-21535
The use of LANDSAT digital data and computer-implemented techniques for an agricultural application
[NASA-RP-1016] N78-21568

DIGITAL SIMULATION
Mathematical simulation of power conditioning systems. Volume 1: Simulation of elementary units. Report on simulation methodology
[NASA-TM-75209] N78-21212
Signal-to-noise ratio estimation in digital computer simulation of lowpass and bandpass systems with applications to analog and digital communications
N78-21329
Development of a unified approach to the simulation of static and dynamic behavior of large mobile hydraulic systems
N78-21395
Numerical simulations of collisionless drift instabilities for low-density plasmas
[PPPL-1382] N78-21930

DIGITAL SYSTEMS
Digital imagery test set
[AD-A049798] N78-21825

DILATATIONAL WAVES
Drift waves in inhomogeneous plasmas with shear and temperature gradients
N78-21919

DIMENSIONS
Contributions to the dimensional theory
N78-21835

DIODES
Tunable diode laser heterodyne spectrometer for balloon-borne solar radiometry in the stratosphere
[SAND-77-0601] N78-21463

DIPOLE ANTENNAS
The circumferential variation of the axial component of the current in closely spaced thin-wire antennas
[AD-A049456] N78-21351

DISCONTINUITY
Two theoretical problems in close binary stars
N78-21995

DISCRETE FUNCTIONS
Discrete variational techniques in finite mathematics
N78-21834

Design of a compensation for an ARMA model of a discrete time system
[NASA-CR-156097] N78-21838
A character formula for the discrete series of a semisimple lie group
N78-21886

DISPERSIONS
Generation of a monodispersed aerosol
[NASA-CR-152133] N78-21445

DISPLAY DEVICES
Results of a simulator test comparing two display concepts for piloted flight-path-angle control
[NASA-TM-78692] N78-21104
Interactive aids for cartography and photo interpretation
[AD-A049768] N78-21578
A control system for depicting information from computer on an electroluminophoric plate
[AD-A049394] N78-21788
Notes on data file exchange between the NRL TIASC and the DTNSRDC CDC-6616700
[AD-A049797] N78-21981

DISSIPATION
Measurement of the changes in dissipation factor and dielectric constant as a method of evaluating degradation in capacitor oils
[AD-A050004] N78-21380

DISTORTION
Experimental validation of the Antenna Pattern Distortion Computer Program, VHF antenna
[AD-A049740] N78-21345

DISTRIBUTED AMPLIFIERS
Analysis of distributed-emission crossed-field amplifiers
[AD-A050185] N78-21391

DISTRIBUTION FUNCTIONS
On the convolution of logistic random variables
[AD-A049996] N78-21876
Some numerical results on asymptotic failure distributions
[AD-A049775] N78-21879

DIVERGENCE
Axiomatic characterization of a family of information measures that contains the directed divergences
[AD-A050096] N78-21983

DOMAINS
Extremal problems in quasiconformal mappings with side conditions
N78-21831

DOMESTIC ENERGY
Fuel and energy price forecasts: Quantities and long-term marginal prices, volume 1
[EPRI-EA-433-VOL-1] N78-21637

DOPED CRYSTALS
Preparation of rare earth doped laser materials
[AD-A049697] N78-21454

DOPPLER EFFECT
Ionospheric effects on the Doppler frequency shift in SARSAT propagation
[CRC-1313] N78-21334

DOPPLER RADAR
Installation and test of Doppler acoustic sensor
[AD-A049562] N78-21893

DRAG
Transonic wind tunnel tests on two-dimensional aerofoil sections. Determination of pressure distribution and drag for an aerofoil with a modified NACA 65 sub2-215 section in FFA wind tunnel S5, part 2
[FFA-TN-AU-725] N78-21062

DRAG REDUCTION
Analytical and numerical investigation of structural response of compliant wall materials
[NASA-CR-156151] N78-21491

DRAINAGE
Investigation of the application of HCMM thermal data to snow hydrology
[E78-10116] N78-21521

DREDGED MATERIALS
An overview of dredging operations in the Chesapeake Bay --- environment effects and coastal ecology
N78-21545

DROPS (LIQUIDS)
The vaporization behavior of a fuel drop on a hot surface --- aircraft fuel drop evaporation
[AD-A049471] N78-21303

DUAL AIR DENSITY EXPLORER
A small gas inlet system for orbital mass-spectrometer calibrations
[NASA-TP-1170] N78-21430

DYNAMIC CHARACTERISTICS
Development of a unified approach to the simulation of static and dynamic behavior of large mobile hydraulic systems
N78-21395
The problem of exit against a flow for dynamical systems
N78-21881

DYNAMIC CONTROL
Multicriteria optimization with uncertainty in the dynamics
[AD-A049541] N78-21830

DYNAMIC LOADS
Studies on the failure of metal mechanical joints subjected to dynamic loads
[AD-A050076] N78-21503

DYNAMIC MODELS
On the period of the coherent structure in boundary layers at large Reynolds numbers
[NASA-TM-78477] N78-21407
Randomized response designs
N78-21871

DYNAMIC MODULUS OF ELASTICITY
The stress clock function in viscoelasticity
N78-21486

DYNAMIC PROGRAMMING
Satellite surveillance avoidance optimization aid --- for naval operations
[AD-A049561] N78-21195
Design of interactive manufacturing and quality systems subject to inspection error using dynamic programming
N78-21481

DYNAMIC RESPONSE
Dynamic response of linear damped continuous structural members
N78-21485
Response functions in a one-dimensional Fermi gas and renormalization-group treatment of one-dimensional kondo lattices
N78-21938

DYNAMIC STABILITY
Dynamic instability analysis of axisymmetric shells by finite element method with convected coordinates
[CONF-770807-34] N78-21505
Stability of an infinite system of differential equations
N78-21833

DYNAMIC STRUCTURAL ANALYSIS
Evaluation of a ceramic combustion chamber for a small gas turbine engine
N78-21145
Dynamic photoelastic and dynamic finite element analyses of dynamic tear test specimens
[AD-A049780] N78-21504

E

EARTH CORE
On the tidal oscillations of the liquid core of the earth
[NASA-TP-1223] N78-21691

EARTH CRUST
Crustal evolution in the early earth: Basin-forming impacts, crustal dichotomy, and plate tectonics
N78-21685
Conductivity of the ocean crust
N78-21686

EARTH ENVIRONMENT
Summary of the active microwave users workshop
N78-21563

EARTH MOVEMENTS
Earthflow
N78-21684
Source parameters and the static field of earthquakes at near distances
N78-21687

EARTH ORBITS
Orbit prediction errors resulting from vertical misalignment of a radar antenna
[AD-A050161] N78-21186
The long-period motion of geosynchronous satellites
N78-21187

EARTH RESOURCES
Heat Capacity Mapping Mission [HCMM] launch
[NASA-TM-79429] N78-21191
Annotated bibliography of natural resource information: Northwestern Colorado
[PB-275997/5] N78-21579
Applications notice --- application of space techniques to earth resources, environment management, and space processing
[AN-OSTA-78-A] N78-21991

EARTH RESOURCES PROGRAM
NCSL task force findings on feasible state uses of LANDSAT
N78-21559
Active Microwave Users Workshop Report
[NASA-CP-2030] N78-21562
Summary of the active microwave users workshop
N78-21563
Applications of active microwave imagery
N78-21564
Seasat land experiments
N78-21565
Active microwave users working group program planning
N78-21566
Evaluation of LANDSAT MSS vs TM simulated data for distinguishing hydrothermal alteration
[NASA-CR-156168] N78-21569
LANCHAD: Remote sensing of the N'Djamena area and the Logone-Chari confluent
[NASA-TM-75087] N78-21570

EARTH SURFACE
Heat Capacity Mapping Mission [HCMM] launch
[NASA-TM-79429] N78-21191
HCMM satellite to take earth's temperature
[NASA-NEWS-RELEASE-78-60] N78-21507

EARTHQUAKES
Source parameters and the static field of earthquakes at near distances
N78-21687
Earthquake prediction uncertainty, and policies for the future: A technology assessment of earthquake prediction
[PB-275581/7] N78-21713

ECCENTRICS
Analytical determination of the Burmester lines for cylindric-cylindric cranks
N78-21465

ECHELETTE GRATINGS
Research directed toward improved echelles for the ultraviolet --- large space teslescope spectrographs
[NASA-CR-156732] N78-21427

ECOLOGY
Annotated bibliography of natural resource information: Northwestern Colorado
[PB-275997/5] N78-21579

ECONOMIC ANALYSIS
Energy conservation via solar energy applications to multi-family and commercial structures. Volume 3: An energy, engineering and economic analysis of heating and cooling systems for multi-family structures
[PB-276131/0] N78-21657
The long-run incremental cost of electric utilities
[PB-276082/5] N78-21660
Technology assessment and forecast report, 8
[PB-276375/3] N78-21989

ECONOMIC FACTORS
Energy conservation in the home: An energy education/conservation curriculum guide for home economics teachers
[EDM-1028] N78-21607

ECONOMIC IMPACT
The automotive fuel economy standards for model year 1981-1984 passenger cars
[PB-275827/4] N78-21314
Rulemaking support paper concerning the 1981-1984 passenger auto average fuel economy standards
[PB-275895/1] N78-21315
Simulation model for resource policy evaluation
[PB-275938/9] N78-21990

ECONOMICS
Geothermal energy potential for district and process heating applications in the US: An economic analysis
[BNWL-2311] N78-21649
Economies available through improved inventory management
[PB-276048/6] N78-21977

ECOSYSTEMS
Regional energetic coupling of man and his environment: Data requirements --- regional planning and ecosystems
N78-21543
Thermal discharges and their role in pending power plant regulatory decisions
N78-21547
Contribution of remote sensing to understand the Bay as a system
N78-21553
Role of remote sensing in Bay measurements
N78-21557
Coastal upwelling ecosystems analysis, data report 39. Joint 2: R/V Thomas G. Thompson cruise 108 leg 1, CTD measurements off the coast of Peru near Cabo Nazca, April - May 1976
[PB-276532/9] N78-21742
Coastal upwelling ecosystems analysis, data report 40. Joint 2: R/V Thomas G. Thompson cruise 108 legs 2 and 3, CTD measurements off the coast of Peru near Cabo Nazca, May - June 1976
[PB-276533/7] N78-21743
Coastal upwelling ecosystems analysis. Data report 41: Physical, chemical and biological observations from JOINT 2 R/V ALPHA HELIX, Leg O, 5-20 March 1976
[PB-276297/9] N78-21745
Coastal upwelling ecosystems analysis. Technical report 34: Physical and biological measurements, 29 July - 5 August 1973
[PB-276486/8] N78-21746

ECUADOR
Identification and tracing of water masses with an application near the Galapagos Islands
N78-21736

EDUCATION
Energy conservation in the home: An energy education/conservation curriculum guide for home economics teachers
[EDM-1028] N78-21607
Adaptive training of perceptual motor skills: Issues, results and future directions
[AD-A050461] N78-21765

EFFLUENTS
Effluent characterization from a conical pressurized fluid bed
[NASA-TM-73897] N78-21596

Atmospheric scavenging of solid rocket exhaust effluents
[NASA-CR-2997] N78-21665
Effluent monitoring procedures: Metals analyses. Student reference manual
[PB-275391/1] N78-21674
Effluent monitoring procedures: Metals analyses. Staff guide for conducting the course
[PB-275393/7] N78-21675

EIGENVALUES
A minimum principle for the smallest eigenvalue for second order linear elliptic equations with natural boundary conditions
[AD-A050101] N78-21851
Semiclassical methods for nonseparable systems
[LBL-6662] N78-21903

ELASTIC CYLINDERS
The torsional analysis of steady state and transient wave propagation in elastic cylinders
N78-21487

ELASTIC DEFORMATION
On the question of equivalent reinforcement of holes in a shell --- using elastically deformed reinforcement rings
N78-21496

ELASTIC PROPERTIES
On the dissipation associated with equilibrium shocks in finite elasticity
[AD-A050031] N78-21501

ELASTIC SHELLS
Transient response of two fluid-coupled spherical elastic shells to an incident pressure pulse
[AD-A049443] N78-21497

ELECTRIC BATTERIES
Manufacturing methods and technology for hermetically sealed lithium SO2 cell batteries
[AD-A049943] N78-21617

ELECTRIC BRIDGES
Nonequilibrium properties of variable-thickness superconducting micro-bridges
[AD-A049779] N78-21381
Intrinsic fluctuation of thin film microbridges
N78-21947

ELECTRIC CHARGE
Stored charge release in cables in low fluence X-ray environments
[AD-A050112] N78-21376

ELECTRIC COILS
A study of the Peninsula Method for the controlled artificial generation of ULF waves in the ionosphere and magnetosphere
[AD-A049514] N78-21354

ELECTRIC CONDUCTORS
Formulation of electrically conductive thermal-control coatings
[NASA-TP-1218] N78-21216
Transient analysis of a finite length cylindrical scatterer very near a perfectly conducting ground, part 2
[AD-A050144] N78-21343

ELECTRIC CONNECTORS
Quantification of printed circuit board (PCB) connector reliability
[AD-A049980] N78-21378

ELECTRIC CURRENT
Prospects for studying gas chemisorption kinetics using current fluctuations
N78-21953

ELECTRIC DISCHARGES
A preliminary study of aerosol initiated CO2 laser produced air sparks and their ability to guide electrical discharges
[AD-A050097] N78-21453

ELECTRIC FIELDS
A study of the field modulated generator system
N78-21371

ELECTRIC FILTERS
Investigation of the turbulent flows of two-phase media
[NASA-TT-F-17059] N78-21408

ELECTRIC GENERATORS
A study of the field modulated generator system
N78-21371

ELECTRIC POWER PLANTS
Use of remote sensing in facility siting
N78-21555
Gasification combined cycle test facility, Pekin, Illinois
[FE-2352-03] N78-21632
Grid-connected integrated community energy system, executive summary, phase 1
[COO/4210-1-SUMM] N78-21638
The long-run incremental cost of electric utilities
[PB-276082/5] N78-21660
Technical assessment of NOx removal processes for utility application
[PB-276637/6] N78-21670

ELECTRIC POWER SUPPLIES
Combined heat and power: A discussion of Energy Paper 20
[ERG-018] N78-21608
Integrating wave power into the electricity supply system
[RR-20] N78-21609
Projected 1977 - 1978 winter electric load-supply situation, contiguous United States
[PB-276269/8] N78-21621
Annual survey of manufactures, 1975. Fuels and electric energy consumed. Statistics for the United States
[PB-275772/2] N78-21659

ELECTRIC PULSES
Pulse ignition characterization of mercury ion thruster hollow cathode using an improved pulse ignitor
[NASA-TM-78858] N78-21203

ELECTRIC WIRE
Analysis of thin-wire antennas in the presence of a dielectric and/or ferrite inhomogeneity
[AD-A049455] N78-21350
The circumferential variation of the axial component of the current in closely spaced thin-wire antennas
[AD-A049456] N78-21351

ELECTRICAL IMPEDANCE
Controlled impedance short circuit limiter
[EPRI-EL-537] N78-21392

ELECTRICAL PROPERTIES
Charging of flexible solar array substrates in kilovolt electron beams
[NASA-TM-73865] N78-21199
Characterization of solar cells for space applications. Volume 1: Electrical characteristics of OCLI violet solar cells as a function of intensity and temperature
[NASA-CR-156162] N78-21601

ELECTRICAL RESISTIVITY
Mass transport and electrical conductivity in oxides containing a submicron dispersion of a second oxide phase
N78-21259
Conductivity of the ocean crust
N78-21686
Analysis of the bipole-dipole resistivity method for geothermal exploration
[LBL-6332] N78-21710

ELECTROCHEMICAL CORROSION
Pitting in aluminum --- copper cathode formation
[AD-A049854] N78-21274

ELECTROCHEMISTRY
Studies of flash-induced photoelectrochemical processes
N78-21229
Alloy corrosion-fundamental studies of dissolution and passivity of alloys and compounds
[AD-A049848] N78-21273
An evaluation of electrochemical concentration Cell [ECC] sonde measurements of atmospheric ozone
[NASA-CR-2973] N78-21429

ELECTROLYSIS
Advanced solid electrolyte cell for CO2 and H2O electrolysis --- for extended duration manned spaceflights
[NASA-CR-152093] N78-21235

ELECTROLYTIC CELLS
Advanced solid electrolyte cell for CO2 and H2O electrolysis --- for extended duration manned spaceflights
[NASA-CR-152093] N78-21235

ELECTROMAGNETIC ABSORPTION
Energy storage and two-photon extraction from metastable states
[AD-A050075] N78-21459
Electroreflectance in semiconductors and its application as a method of materials characterization
N78-21950

ELECTROMAGNETIC COMPATIBILITY
IEMCAP implementation study, volume 1
[AD-A049739] N78-21344
IEMCAP implementation study. Volume 2: Annex electromagaetic compatibility handbook for system development and procurement
[AD-A049738] N78-21357

ELECTROMAGNETIC FIELDS
Shielding by a surface layer of electrons, 1. Weak electromagnetic fields near a black hole, 2.
N78-22003

ELECTROMAGNETIC INTERACTIONS
Evaluation of two computer programs for modeling electromagnetic interactions with surfaces
[UCRL-52321] N78-21368

ELECTROMAGNETIC NOISE
Intrinsic fluctuation of thin film microbridges
N78-21947

ELECTROMAGNETIC PULSES
Numerical results or multiconductor transmission line networks
[AD-A049451] N78-21349

ELECTROMAGNETIC RADIATION
Transient analysis of a finite length cylindrical scatterer very near a perfectly conducting ground, part 2
[AD-A050144] N78-21343
The evaluation and energy propagation of relativistic electron-nucleus Bremsstrahlung and virtual photon spectra
N78-21895
Internal reflection of bounded beams: Effects in the plane of incidence
N78-21910

ELECTROMAGNETIC SHIELDING
Shielding by a surface layer of electrons, 1. Weak electromagnetic fields near a black hole, 2.
N78-22003

ELECTROMAGNETIC SPECTRA
Research investigation directed toward extending the useful range of the electromagnetic spectrum
[NASA-CR-156069] N78-21236

ELECTROMAGNETIC WAVE TRANSMISSION
Small aperture on a multiconductor transmission line filled with inhomogeneous dielectrics --- penetration of electromagnetic pulse
[AD-A050099] N78-21359

ELECTROMETERS
The Plasma Interaction Experiment [PIX] description and test program --- electrometers
[NASA-TM-78863] N78-21188

ELECTRON BEAMS
Electron beam addressed arrays of infrared bolometers
[AD-A049550] N78-21905

ELECTRON BOMBARDMENT
A review of electron bombardment thruster systems/spacecraft field and particle interfaces
[NASA-TM-78850] N78-21206

ELECTRON EMISSION
Study of surface fatigue wear by exoelectron emission
[AD-A049927] N78-21476

ELECTRON ENERGY
A theory of electron energy confinement in Tokamaks --- thermal transport code
[AD-A049505] N78-21923

ELECTRON IMPACT
Vacuum ultraviolet and visible radiation from electron impact excitation of nitrogen, hydrogen, oxygen, the light hydrocarbons and the rare gases
N78-21897

ELECTRON PHONON INTERACTIONS
Broadness of optical impurity spectra in the solid state
N78-21899

ELECTRON SCATTERING
Characterization of surfaces by low energy helium scattering
N78-21941
Improved calculations of X-ray and inelastic electron scattering Compton profiles
[AD-A049513] N78-21960

ELECTRON TUNNELING
Quasiparticle interference effects in the tunneling characteristics of thick superconducting films of zinc
N78-21952

ELECTRONIC COUNTERMEASURES
An ECM-resistant communication and ranging system for remotely piloted vehicles
N78-21080

ELECTROPHORESIS
Separation of lymphocytes by electrophoresis under terrestrial conditions and at zero gravity, phase 3
[NASA-CR-151702] N78-21753

ELECTROPOLISHING
Metallography of commercial lead and lead alloys used in the electricity supply industry
[PB-276437/1] N78-21287

ELECTROSTATIC CHARGE
NASA charging analyzer program: A computer tool that can evaluate electrostatic contamination
[NASA-TM-73889] N78-21372

ELECTROSTATICS
Design of an electrostatic end-plugged plasma-confinement device
[UCRL-79880] N78-21928

ELEMENTARY EXCITATIONS
Quasiparticle interference effects in the tunneling characteristics of thick superconducting films of zinc
N78-21952

ELLIPTICITY
Elliptic systems and numerical transformations
[NASA-TM-79433] N78-21840

EMERGENCIES
Safety evaluation of distress flares and smokes
[AD-A049969] N78-21309

EMISSION
Evaluation of Federal Aviation Administration ion engine exhaust sampling rake
[NASA-CR-135213] N78-21111
Preliminary environmental assessment of combustion modification techniques. Volume 1: Summary
[PB-276680/6] N78-21677
Preliminary environmental assessment of combustion modification techniques. Volume 2: Technical results
[PB-276681/4] N78-21678
Review of diesel combustion models for NOx and smoke emissions
[PB-276350/6] N78-21681

EMISSION SPECTRA
Theory of trace element detection from a static thermal induction plasma
[ATR-78[8209]-1] N78-21233
Emission spectrum of the NU3 band of SF6 at 1780K
[AD-A049865] N78-21242

Anomalous infrared emission from condensing and cooling steam clouds
[AD-A050083] N78-21914
Analysis of Angular Dependent Auger Spectroscopy [ADAS] based on a quasiatomic model
[CONF-770908-6] N78-21966
The structure of the solar transition region and inner corona
N78-22011

EMPLOYEE RELATIONS
The measurement of cooperation and the determination of causal variables for cooperation in a technical environment
N78-21969

ENERGY CONSERVATION
Emergency natural gas purchases: Actions needed to correct program abuses and consumer inequities
[PB-275876/1] N78-21313
Energy conservation in the home: An energy education/conservation curriculum guide for home economics teachers
[EDM-1028] N78-21607
Use of solar energy in Federal Building
[GPO-94-365] N78-21610
Installation energy control system analysis program
[AD-A049488] N78-21615
Energy conservation via solar energy application to multi-family and commercial structures. Volume 2, part 2: Solar energy atlas for New York state
[PB-276130/2] N78-21618
US energy conservation could benefit from experiences of other countries
[PB-276006/4] N78-21619
Planner's energy workbook: A manual for exploring relationships between land use and energy utilization
[BNL-50633] N78-21634
Conservation and the contributions from advanced energy source
[CONF-770870-2] N78-21648
Energy conservation via solar energy applications to multi-family and commercial structures. Volume 3: An energy, engineering and economic analysis of heating and cooling systems for multi-family structures
[PB-276131/0] N78-21657

ENERGY CONSUMPTION
Projected 1977 - 1978 winter electric load-supply situation, contiguous United States
[PB-276269/8] N78-21621
Grid-connected ICES preliminary feasibility analysis and evaluation. Volume 1: Executive summary
[COO/4214-1/1-VOL-1] N78-21641
Energy oriented study of industrial cyclone separators
[TREE-1174] N78-21642
Colder - darker: The energy crisis and low-income Americans; an analysis of impact and options
[PB-275656/7] N78-21656
Annual survey of manufactures, 1975. Fuels and electric energy consumed. Statistics for the United States
[PB-275772/2] N78-21659
Energy supply and environmental impacts: Conventional energy sources
[PB-276410/8] N78-21669

ENERGY CONVERSION
A review of the thermoelectronic laser energy converter [TELEC] program at Lewis Research Center
[NASA-TM-73888] N78-21441
Space electric power design study --- laser energy conversion
[NASA-CR-152031] N78-21590
Combined heat and power: A discussion of Energy Paper 20
[ERG-018] N78-21608
Solar energy for the Naval Shore Establishment
[AD-A050026] N78-21616
Studies on methods of reducing heat losses from flat plate solar collectors, phase 2
[COO/2597-3] N78-21624
Gasification combined cycle test facility, Pekin, Illinois
[FE-2352-03] N78-21632
Study of some recent advances in the concept and design of MHD generators
[AEOI-26] N78-21662

ENERGY CONVERSION EFFICIENCY
Net energy from municipal solid waste
[ORAU/IEA[M]-77-5] N78-21653

ENERGY POLICY
Emergency natural gas purchases: Actions needed to correct program abuses and consumer inequities
[PB-275876/1] N78-21313
Low-Btu coal gasification
[ERHQ-0015] N78-21318
Investigation of converting the product of coal gasification to methane by the action of microorganisms, phase 1
[FE-2203-16] N78-21319
Chemicals from coal: USBM Synthoil
[FE-1534-49] N78-21320
Evaluation of the use of hydrogen as a supplement to natural gas
[TID-27747] N78-21323
Diesel fuel oils, 1977
[BERC/PPS-77/5] N78-21324
System design package for IBM system one: solar heating and domestic hot water
[NASA-CR-150614] N78-21589
Solar heat transport fluid
[NASA-CR-150612] N78-21592
Combined heat and power: A discussion of Energy Paper 20
[ERG-018] N78-21608
Use of solar energy in Federal Building
[GPO-94-365] N78-21610
Incentives for developing new energy sources
[GPO-93-810] N78-21613
US energy conservation could benefit from experiences of other countries
[PB-276006/4] N78-21619
Study of treatment methods for geothermal fluids
[LBL-6337] N78-21622
Distributed technologies in California's energy future, volume 1
[LBL-6831-VOL-1] N78-21623
Geothermal environmental studies, Heber region, Imperial Valley, California. Environmental baseline data acquisition
[EPRI-ER-352] N78-21630
Energy systems analysis and development
[BNL-22969] N78-21633
Distributed technologies in California's energy future: A preliminary report, volume 2
[LBL-6831-VOL-2] N78-21635
Fuel and energy price forecasts: Quantities and long-term marginal prices, volume 1
[EPRI-EA-433-VOL-1] N78-21637
Grid-connected integrated community energy system, executive summary, phase 1
[COO/4210-1-SUMM] N78-21638
Trenton ICES, volume 1, phase 1
[COO/4212-1/1-VOL-1] N78-21639
California residential energy standards: Problems and recommendations relating to implementation, enforcement, design
[SAN/1178-1] N78-21640
Thermodynamics and energy policy
[ORAU-IEA-M-77-18] N78-21643
Proceedings of the Energy Research and Development Administration Conference on Cogeneration and Integrated Energy/Utility Systems
[CONF-770632] N78-21644
Description and comparison of energy impact assessment models
[BNWL-2107] N78-21671
Novel silicon crystals and method for their preparation
[NASA-TM-75195] N78-21957

ENERGY REQUIREMENTS
Projected 1977 - 1978 winter electric load-supply situation, contiguous United States
[PB-276269/8] N78-21621
Grid-connected ICES preliminary feasibility analysis and evaluation. Volume 1: Executive summary
[COO/4214-1/1-VOL-1] N78-21641
Net energy analysis of an Ocean Thermal Energy Conversion [OTEC] system
[ORAU/IEA[M]-77-1] N78-21652
Energy supply and environmental impacts: Conventional energy sources
[PB-276410/8] N78-21669

ENERGY SOURCES
Annual cycle energy system concept and application
[CONF-770870-1] N78-21647
Conservation and the contributions from advanced energy source
[CONF-770870-2] N78-21648

ENERGY STORAGE
Energy storage and two-photon extraction from metastable states
[AD-A050075] N78-21459
Development of a practical photochemical energy storage system
[SRO-893-6] N78-21626
Development of a practical photochemical energy storage system
[SRO-893-8] N78-21627
Development of a practical photochemical energy storage system
[SRO-893-9] N78-21628
Development of a practical photochemical energy storage system
[SRO-893-10] N78-21629
Decision making with interactive access to integrated administrative and technological data bases. An illustrated conceptual overview --- energy storage
[UCRL-80353] N78-21986

ENERGY TECHNOLOGY
Subsystem design package for Solar II collector
[NASA-CR-150611] N78-21602
Incentives for developing new energy sources
[GPO-93-810] N78-21613
The long-run incremental cost of electric utilities
[PB-276082/5] N78-21660

ENERGY TRANSFER
Multivariable computer control of a gas metal arc welding process
N78-21466
Energy transfer at solid surfaces --- thermal emission, thermal conduction and gas-surface energy exchange
N78-21956

ENGINE COOLANTS
A review of techniques for the thermal protection of the walls of the combustion chamber and reheating ducts of turboreactors
N78-21134
Measuring techniques in high temperature turbines
N78-21151
New computation method of turbine blades film cooling efficiency
N78-21154
Calculation of temperature distribution in disks and cooling flow in a transient state
N78-21157

ENGINE DESIGN
Rectangular capture area to circular combustor scramjet engine
[NASA-TM-78657] N78-21107
Technical evaluation report on 50th Propulsion and Energetics Panel Meeting on High Temperature Problems in Gas Turbine Engines
N78-21119
The status of small, cooled, axial-flow turbines
N78-21123
Performance and design of transportation-cooled turbine blading
N78-21129
High temperature H2-Air variable geometry combustor and turbine: Test facility and measurements
N78-21137
Low frequency combustion instability in augmentors
N78-21138
Effects of film injection on performance of a cooled turbine
N78-21147

ENGINE INLETS
Technical evaluation report on 50th Propulsion and Energetics Panel Meeting on High Temperature Problems in Gas Turbine Engines
N78-21119

ENGINE PARTS
Gas path sealing in turbine engines
[NASA-TM-73890] N78-21109
The measurement of film cooling effectiveness on turbine components in short duration wind tunnels
N78-21152

ENGINE TESTS
Hot cascade test results of cooled turbine blades and their application to actual engine conditions
N78-21125
Lightweight, low compression aircraft diesel engine --- converting a spark ignition engine to the diesel cycle
[NASA-CR-135300] N78-21471

ENGINES
Evaluation of Federal Aviation Administration ion engine exhaust sampling rake
[NASA-CR-135213] N78-21111

ENVIRONMENT EFFECTS
Environmental effects on crack growth in flight-simulation tests on 2024-T3 and 7075-T6 material
[NLR-TR-76104-U] N78-21492
Alaskan oil transportation issues
[PB-276449/6] N78-21661
Energy supply and environmental impacts: Conventional energy sources
[PB-276410/8] N78-21669
Preliminary environmental assessment of combustion modification techniques. Volume 1: Summary
[PB-276680/6] N78-21677
Preliminary environmental assessment of combustion modification techniques. Volume 2: Technical results
[PB-276681/4] N78-21678

ENVIRONMENT MANAGEMENT
Regional energetic coupling of man and his environment: Data requirements --- regional planning and ecosystems
N78-21543
Applications notice --- application of space techniques to earth resources, environment management, and space processing
[AN-OSTA-78-A] N78-21991

ENVIRONMENT MODELS
Hydraulic model of the Chesapeake Bay
N78-21539
Air pollution modeling
N78-21663
Description and comparison of energy impact assessment models
[BNWL-2107] N78-21671

ENVIRONMENTAL MONITORING
Use of remote sensing technology provided by the NASA/WFC Chesapeake Bay Ecological Program
N78-21538
LANDSAT sensors
N78-21540
Acoustic remote probing of the environment --- atmospheric and underwater acoustic data acquisition
N78-21542

Relationship of land use to water quality in the Chesapeake Bay region --- water sampling and photomapping river basins
N78-21544
Possible role of remote sensing for increasing public awareness of the Chesapeake Bay environment
N78-21558
ENVIRONMENTAL QUALITY
On measuring the state of the bay
N78-21537
ENVIRONMENTAL SURVEYS
Application of Remote Sensing to the Chesapeake Bay Region. Volume 2: Proceedings
[NASA-CP-6]
N78-21526
The Chesapeake Bay Program: An opportunity to use an innovative monitoring technique
N78-21528
ENVIRONMENTAL TESTS
Geothermal environmental studies, Heber region, Imperial Valley, California. Environmental baseline data acquisition
[EPRI-ER-352]
N78-21630
EPITAXY
Epitaxial growth of semi-insulating GaAs
[AD-A050030]
N78-21961
EPOXY RESINS
Study of environmental effects on thermomechanical behavior of resin-base composites
[AD-A049538]
N78-21225
The physical mechanisms responsible for the weathering of epoxy resins and GFR epoxy resins
[AD-A049796]
N78-21297
Torsional pendulum study on several epoxy/diamine polymers
[AD-A050478]
N78-21299
EQUATIONS OF MOTION
Free electron laser theory
N78-21437
The Landau problem for motions on curves
[AD-A049492]
N78-21828
EQUILIBRIUM EQUATIONS
Theory and simulation of the stability of Bernstein-Greene-Kruskal waves --- vlasov equations and laplace transformation
N78-21918
Some highlights of theoretical and computational plasma physics, part 2
[UCRL-79600-PT-2]
N78-21936
EQUIVALENCE
On the question of equivalent reinforcement of holes in a shell --- using elastically deformed reinforcement rings
N78-21496
EROSION
Erosion prevention and film cooling on vanes
N78-21128
Effect of facility background gases on internal erosion of the 30-cm Hg ion thruster
[NASA-TM-73803]
N78-21205
Erosion of brittle materials by solid particle impact
[AD-A050252]
N78-21296
ERRORS
Orbit prediction errors resulting from vertical misalignment of a radar antenna
[AD-A050161]
N78-21186
ESTIMATES
Estimation following sequential tests
[AD-A049784]
N78-21880
ESTIMATING
Estimation and hypothesis testing for generalized multivariate analysis of covariance models
N78-21832
ESTUARIES
Eutrophication in the Chesapeake Bay
N78-21551
ETHYL ALCOHOL
Effects of ethanol on visual unit activity in the thalamus
[AD-A050922]
N78-21754
ETHYLENE
Mechanism of the decomposition of ethylene at low pressure on the surface of rhenium ribbon at high temperature, 2
[BNWL-TR-254]
N78-21246
EUTECTIC ALLOYS
Gravity segregation of primary particles during solidification of binary eutectiferous alloys
N78-21261
EUTROPHICATION
Eutrophication in the Chesapeake Bay
N78-21551
EVALUATION
The quality of NOAA's ocean research and development program: An evaluation
[PB-277095/6]
N78-21980
EVAPORATION
The vaporization behavior of a fuel drop on a hot surface --- aircraft fuel drop evaporation
[AD-A049471]
N78-21303
EVAPOTRANSPIRATION
Plant cover, soil temperature, freeze, water stress, and evapotranspiration
[E78-10101]
N78-21509
Estimated winter wheat yield from crop growth predicted by LANDSAT --- Kansas
[E78-10112]
N78-21517
An integrated study of earth resources in the state of California using remote sensing techniques
[E78-10115]
N78-21520
EXCITATION
Theory of trace element detection from a static thermal induction plasma
[ATR-78(8209)-1]
N78-21233
Excitation of a wire in a rectangular cavity. Part 1: Theory
[AD-A050073]
N78-21365
Excitation of a wire in a rectangular cavity. Part 2: Computer documentation
[AD-A050074]
N78-21366
Inelastic collisions of excited atoms
[AD-A050037]
N78-21901
Studies of parametric decay instabilities in magneto plasmas
[AD-A049547]
N78-21925
EXHAUST GASES
Evaluation of Federal Aviation Administration ion engine exhaust sampling rake
[NASA-CR-135213]
N78-21111
Unsteady plume and blast field generated by a rocket launch
[AD-A050000]
N78-21213
Baseline gas turbine development program
[COO-2749-18]
N78-21479
Atmospheric scavenging of solid rocket exhaust effluents
[NASA-CR-2997]
N78-21665
CALINE 2: An improved microscale model for the dispersion of air pollutants from a line source
[PB-275683/1]
N78-21676
EXPERIMENTAL DESIGN
The Plasma Interaction Experiment (PIX) description and test program --- electrometers
[NASA-TM-78863]
N78-21188
Space Processing Applications Rocket project SPAR III
[NASA-TM-78137]
N78-21189
Preliminary design package for solar hot water system
[NASA-CR-150617]
N78-21603
EXPLORER 43 SATELLITE
On the average configuration of the geomagnetic tail
[NASA-TM-78116]
N78-21695
EXPLOSIVES
High energy halogen chemistry --- propellants and explosives
[AD-A049555]
N78-21240
Complex formation in RDX, HMX, TNT, and some related compounds: A bibliography
[AD-A050090]
N78-21306
EXPONENTIAL FUNCTIONS
Confidence intervals related to sequential tests for the exponential distribution
[AD-A049758]
N78-21863
EXTERNAL TANKS
Shear strength of fillet welds in aluminum alloy 2219 --- for use on the solid rocket motor and external tank
[NASA-TM-78168]
N78-21495
EXTRAPOLATION
Inertial smoothing and extrapolation of ILS beams: Application to the Airbus A 300 B
N78-21074
EXTRATERRESTRIAL RESOURCES
Utilization of lunar materials and expertise for large scale operations in space: Abstracts --- lunar bases and space industrialization
[NASA-CR-156167]
N78-21180
EXTREMELY LOW FREQUENCIES
Ionospheric reflection and absorption properties of normal modes at ELF
[AD-A049778]
N78-21702
EYE MOVEMENTS
Some problems in assessing oculomotor activity during information retrieval
N78-21763

F

F-111 AIRCRAFT
A brief examination of the flow external to an F-111 intake at Mach 1.6
[ARL/ME-NOTE-357]
N78-21054
FABRICATION
Titanium/beryllium laminates: Fabrication, mechanical properties, and potential aerospace applications
[NASA-TM-73891]
N78-21221
Fabrication of stainless steel clad tubing --- gas pressure bonding
[NASA-CP-135347]
N78-21265
Continued development of doped-germanium photoconductors for astronomical observations at wavelengths from 30 to 120 micrometers
[NASA-CR-152125]
N78-22000
FACTOR ANALYSIS
The measurement of cooperation and the determination of causal variables for cooperation in a technical environment
N78-21969
FAILURE ANALYSIS
Evaluation and expansion of an analytical model for fatigue of notched composite laminates
[NASA-CR-145308]
N78-21219
The time to failure of cables subjected to random loads
[AD-A049585]
N78-21498
Studies on the failure of metal mechanical joints subjected to dynamic loads
[AD-A050076]
N78-21503
Some numerical results on asymptotic failure distributions
[AD-A049775]
N78-21879
FAR INFRARED RADIATION
Far infrared observations of the galactic center
N78-21996
FAR ULTRAVIOLET RADIATION
Generation of coherent VUV and soft X-rays
[AD-A049858]
N78-21450
Vacuum ultraviolet and visible radiation from electron impact excitation of nitrogen, hydrogen, oxygen, the light hydrocarbons and the rare gases
N78-21897
FARMLANDS
Use of satellite images in the evaluation of farmlands --- in Mexico
[NASA-TM-75088]
N78-21575
FATIGUE (MATERIALS)
Report on aircraft fatigue studies --- in-flight monitoring and stress measurements
[AD-A049876]
N78-21102
Evaluation and expansion of an analytical model for fatigue of notched composite laminates
[NASA-CR-145308]
N78-21219
FATIGUE LIFE
Influence of fretting on flexural fatigue of 304 stainless steel and mild steel
[NASA-TP-1193]
N78-21269
Fatigue in adhesively bonded laminates --- aluminum alloy laminates
[AD-A049529]
N78-21271
Rolling-element fatigue life of AISI M-50 and 18-4-1 balls
[NASA-TP-1202]
N78-21473
FATIGUE TESTS
Report on aircraft fatigue studies --- in-flight monitoring and stress measurements
[AD-A049876]
N78-21102
Influence of fretting on flexural fatigue of 304 stainless steel and mild steel
[NASA-TP-1193]
N78-21269
Characterization of wear debris generated in accelerated rolling-element fatigue tests
[NASA-TP-1203]
N78-21470
Rolling-element fatigue life of AISI M-50 and 18-4-1 balls
[NASA-TP-1202]
N78-21473
FEASIBILITY ANALYSIS
Evaluation of the use of hydrogen as a supplement to natural gas
[TID-27747]
N78-21323
A feasibility study of ion implantation techniques for mass spectrometer calibration
[NASA-TP-1185]
N78-21431
FEDERAL BUDGETS
A range of cost measuring risk and uncertainty in major programs: An aid to decision making --- for federal funding
[PB-276384/5]
N78-21979
FEEDBACK
A double integral quadratic cost problem with application to feedback stabilization
[AD-A049533]
N78-21822
A modified quadratic cost problem and feedback stabilization of linear discrete time systems
[AD-A049519]
N78-21883
On feedback stabilization of time varying discrete linear systems
[AD-A049530]
N78-21884
FERMI SURFACES
Response functions in a one-dimensional Fermi gas and renormalization-group treatment of one-dimensional kondo lattices
N78-21938
The Fermi surface of niobium
N78-21942
Long range interactions between atoms absorbed on surfaces
N78-21944
FERROMAGNETIC RESONANCE
The exchange constant of germanium substituted yttrium iron garnet films
N78-21251
FERROMAGNETISM
Characterization of wear debris generated in accelerated rolling-element fatigue tests
[NASA-TP-1203]
N78-21470
Superconductivity, spin-glass properties, and ferromagnetism in amorphous La-Gd-Au alloys
N78-21951

FIBER OPTICS
Fiber Optics Cost Analysis Program [FOCAP]
[AD-A049859] N78-21105
Diffusion process for formation of single-mode waveguide
[AD-A049558] N78-21915
FIELD EFFECT TRANSISTORS
Optical-microwave interactions in semiconductor devices
[AD-A050480] N78-21458
FIELD EMISSION
A scanning ion microscope with a field ionization source
N78-21909
FIGHTER AIRCRAFT
Multi-variate optimization problems of flight vehicle synthesis
[PB-276123/7] N78-21103
Multiband antenna system for tactical aircraft
[AD-A049699] N78-21363
FILLETS
Shear strength of fillet welds in aluminum alloy 2219 --- for use on the solid rocket motor and external tank
[NASA-TM-78168] N78-21495
FILM CONDENSATION
Laminar film condensation of a liquid metal in a vertical channel with variations in wall temperature
N78-21397
FILM COOLING
Flow visualization of film cooling with spanwise injection from a small array of holes and compound-angle injection from a large array
[NASA-TP-1195] N78-21113
Investigation on temperature distribution near film cooled airfoils
N78-21127
Erosion prevention and film cooling on vanes
N78-21128
Performance and design of transportation-cooled turbine blading
N78-21129
The influence of transpiration cooling on turbine blade boundary layer
N78-21130
Experimental evaluation of a transpiration cooled nozzle guide vane
N78-21131
Practical solutions to the cooling of combustors operating at high temperatures
N78-21135
The influence of coolant turbulence intensity of film cooling effectiveness
N78-21136
Systematic studies of heat transfer and film cooling effectiveness
N78-21146
Effects of film injection on performance of a cooled turbine
N78-21147
The measurement of film cooling effectiveness on turbine components in short duration wind tunnels
N78-21152
New computation method of turbine blades film cooling efficiency
N78-21154
FILTRATION
Dynamic hyperfiltration membranes for high-temperature spacecraft wash water recycle
[NASA-CR-151689] N78-21767
FINE STRUCTURE
Temperature fine-structure in the Southern Ocean
N78-21735
FINITE DIFFERENCE THEORY
Numerical study of transonic flow over oscillating airfoils using the full potential equation
[NASA-TP-1120] N78-21055
FINITE ELEMENT METHOD
Finite element analysis of some problems arising in cooled turbine blades
N78-21144
On the dissipation associated with equilibrium shocks in finite elasticity
[AD-A050031] N78-21501
Dynamic instability analysis of axisymmetric shells by finite element method with convected coordinates
[CONF-770807-34] N78-21505
FIRE DAMAGE
Aircrew and passenger protective breathing equipment studies
[AD-A051002] N78-21768
FIXED POINTS [MATHEMATICS]
Stochastic filtering and control
[AD-A049992] N78-21829
FLAME PROPAGATION
Time-dependent fire behavior of aircraft cabin materials
[AD-A050923] N78-21234
FLAME RETARDANTS
Fire resistivity and toxicity studies of candidate aircraft passenger seat materials
[NASA-TM-78468] N78-21214
FLAME SPECTROSCOPY
Local flame temperature measurements by radiative methods
N78-21153
FLAME TEMPERATURE
Local flame temperature measurements by radiative methods
N78-21153
FLAMMABILITY
Fire resistivity and toxicity studies of candidate aircraft passenger seat materials
[NASA-TM-78468] N78-21214
Aircraft cargo compartment fire test simulation program
[NASA-CR-151951] N78-21223
FLARES
Safety evaluation of distress flares and smokes
[AD-A049969] N78-21309
FLASH
Studies of flash-induced photoelectrochemical processes
N78-21229
FLAT PLATES
Experimental investigation of effect of jet decay rate on jet-induced pressures on a flat plate
[NASA-CR-2979] N78-21096
Studies on methods of reducing heat losses from flat plate solar collectors, phase 2
[COO/2597-3] N78-21624
Catalyzed combustion in a flat plate boundary layer. 1: Experimental measurements and comparison with numerical calculations
[LBL-6841] N78-21636
Analysis of data and results for the roundrobin flat-plate collector test program
[PB-275576/7] N78-21655
FLEXING
Experimental investigation of the effects of fluid loading on flexural waves in plates
[AD-A050020] N78-21417
FLIGHT CONTROL
Heavy lift helicopter flight control system. Volume 2: Primary flight control system development and feasibility demonstration
[AD-A049580] N78-21163
FLIGHT CREWS
Aircrew and passenger protective breathing equipment studies
[AD-A051002] N78-21768
FLIGHT MECHANICS
AGARD highlights --- flight mechanics activities
[AGARD-HIGHLIGHTS-78/1] N78-21046
FLIGHT PATHS
Results of a simulator test comparing two display concepts for piloted flight-path-angle control
[NASA-TM-78692] N78-21104
FLIGHT SAFETY
Investigation to support phase 1 of the USAF midair prevention systems program [MAPS]
[AD-A049743] N78-21066
FLIGHT SIMULATION
Evaluation of windshield materials subjected to simulated supersonic flight
[AD-A049981] N78-21101
Results of a simulator test comparing two display concepts for piloted flight-path-angle control
[NASA-TM-78692] N78-21104
Environmental effects on crack growth in flight-simulation tests on 2024-T3 and 7075-T6 material
[NLR-TR-76104-U] N78-21492
FLIGHT SIMULATORS
Results of a simulator test comparing two display concepts for piloted flight-path-angle control
[NASA-TM-78692] N78-21104
Cost-effectiveness of flight simulators for military training. Volume 2: Estimating costs of training in simulators and aircraft
[AD-A049979] N78-21168
Training device design: The simulation/ stimulation controversy
[AD-A049973] N78-21169
FLIGHT TESTS
Calibration of an IRS based on flight data
N78-21076
Development of the integrated all-weather navigation system for tornado [MRCA]
N78-21089
Results of a simulator test comparing two display concepts for piloted flight-path-angle control
[NASA-TM-78692] N78-21104
Results from flight and simulator studies of a Mach 3 cruise longitudinal autopilot
[NASA-TP-1180] N78-21160
Planned flight test of a mercury ion auxiliary propulsion system. Part 2: Integration with host spacecraft
[NASA-TM-78869] N78-21209
FLIGHT TRAINING
Cost-effectiveness of flight simulators for military training. Volume 2: Estimating costs of training in simulators and aircraft
[AD-A049979] N78-21168
Evaluation of the transfer and cost effectiveness of a complex computer-assisted flight procedure trainer
[AD-A050413] N78-21764
Visual-proprioceptive cue conflicts in the control of remotely piloted vehicles
[AD-A049706] N78-21770
Human performance in aviation systems
[AD-A050078] N78-21771
FLIR DETECTORS
Automated image enhancement techniques for second generation FLIR
[AD-A049564] N78-21913
FLOOD PLAINS
LANCHAD: Remote sensing of the N'Djamena area and the Logone-Chari confluent
[NASA-TM-75087] N78-21570
FLORIDA
Aquifer test analyses for the Floridan aquifer in Flagler, Putnam, and St. Johns counties, Florida
[PB-275790/4] N78-21583
FLOW CHARACTERISTICS
Theoretical flow characteristics of inlets for tilting-nacelle VTOL aircraft
[NASA-TP-1205] N78-21114
Flow of viscous gas in the region of a slot with strong suction
[NASA-TM-75241] N78-21411
FLOW DEFLECTION
APL radiometer wind tunnel test program
[BSR-4188] N78-21401
FLOW DISTRIBUTION
Flow field visualization about external axial corners
[NASA-TM-78682] N78-21056
Experiments related to external burning for propulsion
[AD-A047623] N78-21241
FLOW GEOMETRY
Flow and heat transfer in rotating coolant channels
N78-21156
FLOW RESISTANCE
The problem of exit against a flow for dynamical systems
N78-21881
FLOW STABILITY
Current pulse generator with amplitude of 1,000,000 A and stability of plus or minus .001 at a repetition rate of two Hz
[AD-A049390] N78-21390
Higher order effects, stability and transition in vertical natural convection flows
N78-21394
FLOW VELOCITY
Mean velocity, turbulence intensity and turbulence convection velocity measurements for a convergent nozzle in a free jet wind tunnel
[NASA-CR-2949] N78-21058
A comparison between predicted and measured species concentrations and velocities in a research combustor
N78-21158
Catalyzed combustion in a flat plate boundary layer. 1: Experimental measurements and comparison with numerical calculations
[LBL-6841] N78-21636
FLOW VISUALIZATION
Flow field visualization about external axial corners
[NASA-TM-78682] N78-21056
Flow visualization of film cooling with spanwise injection from a small array of holes and compound-angle injection from a large array
[NASA-TP-1195] N78-21113
FLUID BOUNDARIES
Transient response of two fluid-coupled spherical elastic shells to an incident pressure pulse
[AD-A049443] N78-21497
FLUID DYNAMICS
Summer faculty systems design program. Integrating wind tunnels and computers. Volume 1: Executive summary. USAF/OSR/ASEE
[AD-A050072] N78-21171
Unsteady plume and blast field generated by a rocket launch
[AD-A050000] N78-21213
Sound transmission from a tapered fluid layer into a fast bottom
[AD-A050021] N78-21892
Static and dynamic textures in superfluid He-3 --- Landau-Ginzburg equations
N78-21954
FLUID FLOW
Effects of impurities on shock wave stability and structure in ionizing monatomic gases
[UTIAS-TN-212] N78-21405
The execution of systematic measurements on plane cascades
[NASA-TM-75278] N78-21413
Analysis of temperature compensating circuits for hot-wires and hot-films
[AD-A050080] N78-21432
Owens-Illinois liquid solar collector materials assessment
[NASA-TM-78163] N78-21597
FLUID INJECTION
Flow visualization of film cooling with spanwise injection from a small array of holes and compound-angle injection from a large array
[NASA-TP-1195] N78-21113
FLUID LOGIC
A synthesis technique for the resolution of large scale fluid logic networks
N78-21400
FLUIDICS
Solar heat transport fluid
[NASA-CR-150612] N78-21592

FLUORESCENCE
Local flame temperature measurements by radiative methods
N78-21153

FLUORINE COMPOUNDS
Inorganic halogenoxidizer research
[AD-A050133] N78-21238

FLUORO COMPOUNDS
Surface chemistry of fluoropolymer barrier films: Relation of solution variables to film properties
[AD-A050003] N78-21298

FLUX [RATE]
Effect of flux flow on self-field instability
[ORNL/TM-5986] N78-21967

FORECASTING
Upper ocean thermal structure forecast evaluation of a model using synoptic data
[AD-A048526] N78-21739
Statistical analysis of a forecasting model using one-dimensional nonlinear transformations
N78-21843
Technology assessment and forecast report, 8
[PB-276375/3] N78-21989

FOREST MANAGEMENT
Operational programs in forest management and priority in the utilization of remote sensing
N78-21531

FORESTS
Inventory of forest resources [including water] by multi-level sampling — nine northern Virginia coastal plain counties
[E78-10118] N78-21522

FORGING
Application of superplastic steels — thermomechanical forging of carbon steels
[AD-A049469] N78-21270

FORMALDEHYDE
Ultraviolet photoemission studies of formaldehyde and related molecules absorbed on Ru[110]
[AD-A049661] N78-21239

FORMING TECHNIQUES
Code of practice for the cupping test for sheet and strip metal [modified Erichsen test]
[SABS-0138-1977] N78-21263

FOURIER TRANSFORMATION
The Fermi surface of niobium
N78-21942

FRACTURE MECHANICS
Report on aircraft fatigue studies — in-flight monitoring and stress measurements
[AD-A049876] N78-21102
A fracture mechanics analysis of the kinetics of stress-corrosion crack growth in a high-strength 12Ni-5Cr-3Mo maraging steel
N78-21256
Fatigue in adhesively bonded laminates — aluminum alloy laminates
[AD-A049529] N78-21271
Nondestructive evaluation of metal fatigue
[AD-A049539] N78-21277
On the question of the fracture mechanism for solid polymers
N78-21290
Systems of generalized Abel integral equations
[AD-A050001] N78-21857

FRACTURE STRENGTH
In situ ply strength: An initial assessment — using laminate fracture data and a least squares method
[NASA-TM-73771] N78-21220
Mixed-mode fracture of graphite/epoxy composites
[AD-A049528] N78-21224
A study of the effect of carbon upon the elevated temperature mechanical, fracture and static load crack extension behavior of austenitic stainless steel
N78-21255

FREE ELECTRONS
Free electron laser theory
N78-21437

FREE FLOW
The effect of free-stream turbulence upon heat transfer to turbine blading
N78-21155

FREE JETS
Mean velocity, turbulence intensity and turbulence convection velocity measurements for a convergent nozzle in a free jet wind tunnel
[NASA-CR-2949] N78-21058

FREEZING
Plant cover, soil temperature, freeze, water stress, and evapotranspiration
[E78-10101] N78-21509

FREON
Comparison of aerodynamic data measured in air and Freon-12 wind-tunnel test mediums
[NASA-TM-78671] N78-21052

FREQUENCIES
Emission spectrum of the NU3 band of SF6 at 1780K
[AD-A049865] N78-21242

FREQUENCY ANALYZERS
Experimental solar radio spectrum analyzer [50-100 MHz]
[NASA-CR-156079] N78-22012

FREQUENCY MODULATION
Orbiter S-band FM system console test procedure
[NASA-CR-151694] N78-21338

FREQUENCY SHIFT
Ionospheric effects on the Doppler frequency shift in SARSAT propagation
[CRC-1313] N78-21334

FREQUENCY STABILITY
Surface acoustic wave stabilized oscillators
[NASA-CR-156724] N78-21374
Optically pumped mercury laser for absolute frequency stabilization
N78-21440

FRETTING
Influence of fretting on flexural fatigue of 304 stainless steel and mild steel
[NASA-TP-1193] N78-21269

FUEL CONSUMPTION
Fuel conservation merits of advanced turboprop transport aircraft
[NASA-CR-152096] N78-21095
The automotive fuel economy standards for model year 1981-1984 passenger cars
[PB-275827/4] N78-21314
Rulemaking support paper concerning the 1981-1984 passenger auto average fuel economy standards
[PB-275895/1] N78-21315
Annual survey of manufactures, 1975. Fuels and electric energy consumed. Statistics for the United States
[PB-275772/2] N78-21659

FUEL INJECTION
Photographic characterization of spark-ignition engine fuel injectors
[NASA-TM-78830] N78-21110

FUEL OILS
Alternative fuels for transportation: Implications of the broad-cut option
[UCRL-52313] N78-21322
Diesel fuel oils, 1977
[BERC/PPS-77/5] N78-21324

FUEL SYSTEMS
Fuel pressure increase limiter
[AD-A049393] N78-21117

FUEL TANKS
Design, fabrication, and testing of a full-scale breadboard in nitrogen generator for fuel tank inerting application
[AD-A049459] N78-21097

FUEL-AIR RATIO
Nitric oxide formation in gas turbine engines: A theoretical and experimental study
[NASA-CR-2977] N78-21116

FUNCTIONAL ANALYSIS
The convergence of functions to fixed points of recursive definitions
[AD-A049760] N78-21866

FUNCTIONS [MATHEMATICS]
Quasiclassical methods in the linear Heisenberg model
N78-21940

FURNACES
American Air Filter Kinpactor 10 x 56 venturi scrubber evaluation
[PB-276716/8] N78-21682

G

GADOLINIUM
Superconductivity, spin-glass properties, and ferromagnetism in amorphous La-Gd-Au alloys
N78-21951

GALACTIC STRUCTURE
Far infrared observations of the galactic center
N78-21996

GALERKIN METHOD
Unsteady two dimensional airloads acting on oscillating thin airfoils in subsonic ventilated wind tunnels
[NASA-CR-2967] N78-21059

GALLIUM ARSENIDES
Epitaxial growth of semi-insulating GaAs
[AD-A050030] N78-21961
Thin films of gallium arsenide on low-cost substrates
[SAN/1202-77/2] N78-21965

GAME THEORY
Multicriteria optimization with uncertainty in the dynamics
[AD-A049541] N78-21830

GAMMA RAYS
Gamma-ray astronomy and the origin of cosmic rays
[NASA-TM-79535] N78-22017

GAPS [GEOLOGY]
A geophysical investigation of the oceanographer fracture zone and the mid-Atlantic ridge in the vicinity of 35 deg north
N78-21683

GARP ATLANTIC TROPICAL EXPERIMENT
World weather program. Plan for fiscal year 1978
[PB-276479/3] N78-21718

GAS ANALYSIS
Comparison of wet chemical and instrumental methods for measuring airborne sulfate
[PB-276620/2] N78-21248

GAS DENSITY
X-ray diffraction studies of helium four
N78-21226

GAS DISCHARGES
Small scale discharge studies
[AD-A049551] N78-21456

GAS DYNAMICS
Two theoretical problems in close binary stars
N78-21995

GAS FLOW
Time- and space-resolved species determination in diesel combustion using continuous flow gas sampling
N78-21227
Flow of viscous gas in the region of a slot with strong suction
[NASA-TM-75241] N78-21411
A method of calibrating wind velocity sensors with a modified gas flow calibrator
[NASA-TM-78707] N78-21426

GAS GENERATORS
Design, fabrication, and testing of a full-scale breadboard in nitrogen generator for fuel tank inerting application
[AD-A049459] N78-21097
Inorganic halogenoxidizer research
[AD-A050133] N78-21238

GAS LASERS
Data compendium for atmospheric laser propagation studies conducted at Cape Canaveral, Florida, February - May 1977
[AD-A050094] N78-21452
Small scale discharge studies
[AD-A049551] N78-21456

GAS MIXTURES
Evaluation of the use of hydrogen as a supplement to natural gas
[TID-27747] N78-21323

GAS PRESSURE
Fabrication of stainless steel clad tubing — gas pressure bonding
[NASA-CP-135347] N78-21265

GAS TEMPERATURE
Temperature profile of graphite surface burning in a stream of oxygen
[NASA-TM-75271] N78-21232

GAS TUNGSTEN ARC WELDING
Multivariable computer control of a gas metal arc welding process
N78-21466
Code of practice for welding. Part 7: Welders' competence tests for manual metal-arc, manual inert gas-shielded tungsten-arc, and manual inert gas-shielded metal-arc welding of austenitic stainless and austenitic heat resisting steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-7-1976] N78-21468

GAS TURBINE ENGINES
Nitric oxide formation in gas turbine engines: A theoretical and experimental study
[NASA-CR-2977] N78-21116
High temperature problems in gas turbine engines
[AGARD-CP-229] N78-21118
Technical evaluation report on 50th Propulsion and Energetics Panel Meeting on High Temperature Problems in Gas Turbine Engines
N78-21119
Project optimisation of military gas turbines with respect to turbine life
N78-21120
Problems concerning high temperatures in small turbomachines
N78-21121
Progress in advanced high temperature turbine materials, coatings, and technology
N78-21122
The status of small, cooled, axial-flow turbines
N78-21123
Adapting a turbine engine test stand for high temperature research
N78-21124
Hot cascade test results of cooled turbine blades and their application to actual engine conditions
N78-21125
Investigations of the local heat transfer coefficient of a convection cooled rotor blade
N78-21126
Investigation on temperature distribution near film cooled airfoils
N78-21127
Erosion prevention and film cooling on vanes
N78-21128
Performance and design of transportation-cooled turbine blading
N78-21129
The influence of transpiration cooling on turbine blade boundary layer
N78-21130
Experimental evaluation of a transpiration cooled nozzle guide vane
N78-21131
Heat transfer characteristics of the closed thermosyphon system
N78-21132
Heat transfer from turbine and compressor discs
N78-21133
Practical solutions to the cooling of combustors operating at high temperatures
N78-21135

The influence of coolant turbulence intensity of film cooling effectiveness
N78-21136
High temperature H2-Air variable geometry combustor and turbine: Test facility and measurements
N78-21137
Low frequency combustion instability in augmentors
N78-21138
New materials for high temperature turbines: ONERA's DS composites confronted with the blade problems
N78-21139
Cobalt-base alloys for hot corrosion protective coatings
N78-21142
Evaluation of a ceramic combustion chamber for a small gas turbine engine
N78-21145
Systematic studies of heat transfer and film cooling effectiveness
N78-21146
Effects of film injection on performance of a cooled turbine
N78-21147
Measuring techniques in high temperature turbines
N78-21151
The measurement of film cooling effectiveness on turbine components in short duration wind tunnels
N78-21152
New computation method of turbine blades film cooling efficiency
N78-21154
The effect of free-stream turbulence upon heat transfer to turbine blading
N78-21155
Calculation of temperature distribution in disks and cooling flow in a transient state
N78-21157
Hydrodynamic air lubricated compliant surface bearing for an automotive gas turbine engine. 1: Journal bearing performance
[NASA-CR-135368] N78-21472
Baseline gas turbine development program
[COO-2749-18] N78-21479

GAS TURBINES
High Temperature Turbine Technology Program. Phase 1: Program and system definition. Topical report: Low BTU gas combustor technology development plan
[FE-2290-26] N78-21480

GAS WELDING
Code of practice for welding. Part 5: Welders' competence tests for manual oxy-acetylene, manual metal-arc, manual gas-shielded tungsten-arc, and manual gas-shielded metal-arc welding of mild steel [carbon steel] and medium high tensile steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-5-1976-REV-1]
N78-21467

GAS-METAL INTERACTIONS
Prospects for studying gas chemisorption kinetics using current fluctuations
N78-21953
Energy transfer at solid surfaces — thermal emission, thermal conduction and gas-surface energy exchange
N78-21956

GASES
Study of the effects of gaseous environments on sulfidation attack of superalloys
[NASA-CR-135348] N78-21268
Thermochemical and kinetic data of gaseous metal oxides and their relationship to atmospheric composition
[AD-A050162] N78-21700
Algae, ultraviolet light, and the production of trace gases
[AD-A049441] N78-21748
Response functions in a one-dimensional Fermi gas and renormalization-group treatment of one-dimensional kondo lattices
N78-21938
Relativistic neutron gas interacting through a spin 2 field and its astrophysical applications
N78-22004

GEOCHEMISTRY
Petrography and geochemistry of Precambrian rocks from GT-2 and EE-1
[LA-6930-MS] N78-21709

GEOCHRONOLOGY
Standard techniques for presentation and analysis of crater size-frequency data
[NASA-TM-79730] N78-22006

GEOGRAPHIC APPLICATIONS PROGRAM
Maryland Automated Geographic Information System
N78-21534

GEOIDS
GEOFAST: A fast gravimetric estimation algorithm
[AD-A047611] N78-21706

GEOLOGICAL FAULTS
A geophysical investigation of the oceanographer fracture zone and the mid-Atlantic ridge in the vicinity of 35 deg north
N78-21683

GEOLOGICAL SURVEYS
Activities of the US Geological Survey in Applications of Remote Sensing in the Chesapeake Bay Region
N78-21530
Remote sensing, geology, and land use
N78-21533

GEOLOGY
Remote sensing applied to geological mapping; comparative geomorphology and identification of mineral zones of zinc and lead in the region of Vazante, MG — Brazil
[E78-10108] N78-21514
Geologic application of thermal inertia imaging using HCMM data — Death Valley, California
[E78-10119] N78-21523

GEOMAGNETIC MICROPULSATIONS
A division of the aa indices into six classes based on the Ap' index, 1868-1976
[PB-276388/6] N78-21708

GEOMAGNETIC TAIL
On the average configuration of the geomagnetic tail
[NASA-TM-78116] N78-21695

GEOMAGNETISM
A division of the aa indices into six classes based on the Ap' index, 1868-1976
[PB-276388/6] N78-21708

GEOMETRY
A three-dimensional potential-flow program with a geometry package for input data generation
[NASA-CR-145311] N78-21047

GEOMORPHOLOGY
Remote sensing applied to geological mapping; comparative geomorphology and identification of mineral zones of zinc and lead in the region of Vazante, MG — Brazil
[E78-10108] N78-21514
Metric remote sensing experiments in preparation for Spacelab flights — alpine geomorphology and ice and/or snow cover
[NASA-TM-75093] N78-21571
Snow parameters from Nimbus-6 electrically scanned microwave radiometer — [ESMR-6]
[NASA-CR-156725] N78-21572

GEOPHYSICS
Translations on USSR science and technology: Physical sciences and technology, no. 33
[JPRS-70946] N78-21183
A geophysical investigation of the oceanographer fracture zone and the mid-Atlantic ridge in the vicinity of 35 deg north
N78-21683
Use of the method of one-dimensional nonlinear transformations to forecast the natural model of an oil stratum
N78-21693
Technology assessment and forecast report, 8
[PB-276375/3] N78-21989
National Science Foundation — research projects and technology assessment
[NSF-77-1] N78-22018

GEORGIA
Aircraft accident report: Southern Airways Inc., DC-9-31, N1335U, New Hope, Georgia, April 4, 1977
[NTSB-AAR-78-3] N78-21064

GEOS 3 SATELLITE
Remote sensing of Gulf Stream using GEOS-3 radar altimeter
[NASA-TP-1209] N78-21737

GEOTHERMAL ENERGY CONVERSION
Definition of requirements for geothermal power conversion system studies
[UCRL-13751] N78-21650

GEOTHERMAL RESOURCES
Study of treatment methods for geothermal fluids
[LBL-6337] N78-21622
Distributed technologies in California's energy future, volume 1
[LBL-6831-VOL-1] N78-21623
Geothermal environmental studies, Heber region, Imperial Valley, California. Environmental baseline data acquisition
[EPRI-ER-352] N78-21630
Results of reservoir evaluation tests, 1976 East Mesa Geothermal Field, California
[LBL-6369] N78-21631
Geothermal energy potential for district and process heating applications in the US: An economic analysis
[BNWL-2311] N78-21649
Study of practical cycles for geothermal power plants
[COO-2619-1] N78-21651
Analysis of the bipole-dipole resistivity method for geothermal exploration
[LBL-6332] N78-21710

GERMANIUM
The exchange constant of germanium substituted yttrium iron garnet films
N78-21251
Metastable metallic superconductors with high transition temperatures and composite superconductors
[AD-A050055] N78-21282

GERMANIUM COMPOUNDS
Properties of new superconducting materials — niobium and germanium compounds
[AD-A050296] N78-21959
Continued development of doped-germanium photoconductors for astronomical observations at wavelengths from 30 to 120 micrometers
[NASA-CR-152125] N78-22000

GLASS
Relationships between structure and micromechanics of solvent crazes in glassy polymers
N78-21288
Laser-fusion studies at NRL: A report to ERDA
[AD-A050089] N78-21451

GLASS FIBER REINFORCED PLASTICS
The physical mechanisms responsible for the weathering of epoxy resins and GFR epoxy resins
[AD-A049796] N78-21297

GLASS FIBERS
Parabolic profiling by the molecular stuffing process
N78-21908

GLOBAL ATMOSPHERIC RESEARCH PROGRAM
World weather program. Plan for fiscal year 1978
[PB-276479/3] N78-21718

GOLD ALLOYS
Superconductivity, spin-glass properties, and ferromagnetism in amorphous La-Gd-Au alloys
N78-21951

GOVERNMENTS
Summaries of conclusions and recommendations on the operations of civil departments and agencies
[PB-276094/0] N78-21976

GRADIENTS
High altitude limit of the gradient drift instability
[AD-A049503] N78-21698
A gradient projection-multiplier method for nonlinear programming
[AD-A049864] N78-21811

GRAINS [FOOD]
Heat capacity mapping mission ground measurements — Dunnigan, California
[E78-10113] N78-21518

GRAPHITE
Study of environmental effects on thermomechanical behavior of resin-base composites
[AD-A049538] N78-21225
Temperature profile of graphite surface burning in a stream of oxygen
[NASA-TM-75271] N78-21232

GRAPHITE-EPOXY COMPOSITE MATERIALS
Mixed-mode fracture of graphite/epoxy composites
[AD-A049528] N78-21224
Simple torsion test for shear moduli determination of orthotropic composites
[NASA-TM-78485] N78-21490

GRAVITATIONAL EFFECTS
Gravity segregation of primary particles during solidification of binary eutectiferous alloys
N78-21261

GRAVITATIONAL FIELDS
GEOFAST: A fast gravimetric estimation algorithm
[AD-A047611] N78-21706

GRAVITY ANOMALIES
GEOFAST: A fast gravimetric estimation algorithm
[AD-A047611] N78-21706

GRAVITY WAVES
Internal gravity wave generation by vortex wakes
[AD-A049515] N78-21699

GREASES
Inertial cascade impactor substrate media for flue gas sampling
[PB-276583/2] N78-21668

GREAT PLAINS CORRIDOR [NORTH AMERICA]
Application of wheat yield model to United States and India — Great Plains
[E78-10109] N78-21515

GROUND SUPPORT EQUIPMENT
Precise enroute navigation based on ground-derived techniques
N78-21078

GROUND TRUTH
Geologic application of thermal inertia imaging using HCMM data — Death Valley, California
[E78-10119] N78-21523

GROUND WATER
HCMM energy budget data as a model input for assessing regions of high potential groundwater pollution
[E78-10111] N78-21516
Water resources data for Washington, water year 1976. Volume 1: Western Washington
[PB-275886/0] N78-21581
Water resources data for Washington, water year 1976. Volume 2: Eastern Washington
[PB-275887/8] N78-21582
Water resources data for California, water year 1976. Volume 3: Southern central valley basins, and the great basin from Walker River to Truckee River
[PB-276354/8] N78-21586

GROUND WAVE PROPAGATION
Computation of groundwave attenuation over irregular and inhomogeneous ground at low and medium frequencies
[BBC-RD-1978/7] N78-21332
GROUND-AIR-GROUND COMMUNICATIONS
Target acquisition contours generated for RCAG/BUEC sites in the contiguous United States
[AD-A050978] N78-21335
GUIDANCE [MOTION]
Sandia inertial terrain-aided navigation system
[SAND-77-0521] N78-21070
Applications of Advances in Navigation to Guidance and Control
[AGARD-CP-220] N78-21071
UHF DF triangulation system for control and guidance of military aircraft
N78-21077
GUIDANCE SENSORS
A 4D approach control using VOR/DME/ILS guidance
N78-21083
GUIDE VANES
Use of leaning vanes in a two stage fan
[NASA-CR-152134] N78-21115
Experimental evaluation of a transpiration cooled nozzle guide vane
N78-21131
A new transient cascade facility for the measurement of heat transfer rates
N78-21149
GULF STREAM
Remote sensing of Gulf Stream using GEOS-3 radar altimeter
[NASA-TP-1209] N78-21737
GUST LOADS
A small aircraft gust-probe system
[PB-276429/8] N78-21106
GYROSCOPES
Optically pumped mercury lasers for ring laser gyroscope applications
[AD-A049540] N78-21455

H

HABITATS
Use of LANDSAT data to assess waterfowl habitat quality
[E78-10120] N78-21524
Annotated bibliography of natural resource information: Northwestern Colorado
[PB-275997/5] N78-21579
HALOGEN COMPOUNDS
The use of halons as fire suppressants: A literature survey
[AD-A050098] N78-21237
HALOGENS
High energy halogen chemistry --- propellants and explosives
[AD-A049555] N78-21240
Study of metastable rare gas collisions with halogens
[AD-A049829] N78-21449
HANDBOOKS
IEMCAP implementation study. Volume 2: Annex electromagnetic compatibility handbook for system development and procurement
[AD-A049738] N78-21357
Planner's energy workbook: A manual for exploring relationships between land use and energy utilization
[BNL-50633] N78-21634
HARDNESS TESTS
Tables of Brinell and Vickers hardness values for metallic materials with flat surfaces, and of correction factors [Vickers] for curved surfaces
[SABS-055A-1977] N78-21262
Code of practice for methods for hardness testing of metallic materials
[SABS-055-1977-REV-1] N78-21264
HARMONIC GENERATORS
Calculation of optimum operating parameters for a gyrotron traveling wave amplifier
[AD-A049506] N78-21375
HARMONIC OSCILLATION
A note on multicyclic control by swashplate oscillation
[NASA-TM-78475] N78-21159
HASTELLOY [TRADEMARK]
Composition of eta carbide in Hastelloy N after aging 10000 hr at 815 C
[ORNL-5340] N78-21283
HAZARDS
Technology for return of planetary samples, 1977
[NASA-CR-156169] N78-21181
HEAT CAPACITY MAPPING MISSION
Heat Capacity Mapping Mission [HCMM] launch
[NASA-TM-79429] N78-21191
HCMM satellite to take earth's temperature
[NASA-NEWS-RELEASE-78-60] N78-21507
Plant cover, soil temperature, freeze, water stress, and evapotranspiration
[E78-10101] N78-21509
HCMM energy budget data as a model input for assessing regions of high potential groundwater pollution
[E78-10111] N78-21516
Heat capacity mapping mission ground measurements --- Dunnigan, California
[E78-10113] N78-21518
Investigation of the application of HCMM thermal data to snow hydrology
[E78-10116] N78-21521
Geologic application of thermal inertia imaging using HCMM data --- Death Valley, California
[E78-10119] N78-21523
HEAT EXCHANGERS
Pavement heating: Executive summary
[PB-276504/8] N78-21327
Enhancement of heat transfer by flow pulsations
N78-21398
Problems of hydrodynamics and heat exchange
[NASA-TT-F-17060] N78-21409
Prototype solar heated hot water systems and double-walled heat exchangers: A collection of quarterly reports
[NASA-CR-150591] N78-21591
HEAT MEASUREMENT
Systematic studies of heat transfer and film cooling effectiveness
N78-21146
A new transient cascade facility for the measurement of heat transfer rates
N78-21149
The effect of varying quench rates and heating rates on the aging response of an aluminum powder alloy
[AD-A049744] N78-21272
HEAT RESISTANT ALLOYS
New materials for high temperature turbines: ONERA's DS composites confronted with the blade problems
N78-21139
Strength enhancement process for prealloyed powder superalloys
[NASA-TM-78834] N78-21266
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and in 100
[NASA-TM-78828] N78-21267
Study of the effects of gaseous environments on sulfidation attack of superalloys
[NASA-CR-135348] N78-21268
Composition of eta carbide in Hastelloy N after aging 10000 hr at 815 C
[ORNL-5340] N78-21283
Code of practice for welding. Part 7: Welders' competence tests for manual metal-arc, manual inert gas-shielded tungsten-arc, and manual inert gas-shielded metal-arc welding of austenitic stainless and austenitic heat resisting steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-7-1976] N78-21468
HEAT SOURCES
General-purpose heat source project, space nuclear safety program, and radioisotopic terrestrial safety program
[LA-7003-PR] N78-21906
HEAT STORAGE
Thermophysical properties and behavioral characteristics of phase-change materials
[CONF-770955-2] N78-21218
Design method for heat loss calculation for in-ground heat storage tanks
[COO-2923-3] N78-21625
HEAT TRANSFER
Heat transfer characteristics of the closed thermosyphon system
N78-21132
Heat transfer from turbine and compressor discs
N78-21133
Finite element analysis of some problems arising in cooled turbine blades
N78-21144
Systematic studies of heat transfer and film cooling effectiveness
N78-21146
A new transient cascade facility for the measurement of heat transfer rates
N78-21149
Heat transfer to a PVD rotor blade at high subsonic passage throat Mach numbers
N78-21150
The measurement of film cooling effectiveness on turbine components in short duration wind tunnels
N78-21152
The effect of free-stream turbulence upon heat transfer to turbine blading
N78-21155
Flow and heat transfer in rotating coolant channels
N78-21156
Enhancement of heat transfer by flow pulsations
N78-21398
Heat transfer in continuum and rarefied gases
N78-21399
Heat transfer research and power cycle transient modeling
[COO-2641-4] N78-21424
Solar heat transport fluid
[NASA-CR-150612] N78-21592
HEAT TRANSFER COEFFICIENTS
Investigations of the local heat transfer coefficient of a convection cooled rotor blade
N78-21126
HEAT TRANSMISSION
HCMM energy budget data as a model input for assessing regions of high potential groundwater pollution
[E78-10111] N78-21516
HEATING
Combined heat and power: A discussion of Energy Paper 20
[ERG-018] N78-21608
Installation energy control system analysis program
[AD-A049488] N78-21615
Grid-connected integrated community energy system, executive summary, phase 1
[COO/4210-1-SUMM] N78-21638
Solar space heating systems using annual heat storage
[COO/2939-1] N78-21645
Annual cycle energy system concept and application
[CONF-770870-1] N78-21647
Geothermal energy potential for district and process heating applications in the US: An economic analysis
[BNWL-2311] N78-21649
HEAVY IONS
Structure of multiply ionized heavy ions and associated collision phenomena
[AD-A049762] N78-21902
HEAVY LIFT HELICOPTERS
Heavy lift helicopter flight control system. Volume 2: Primary flight control system development and feasibility demonstration
[AD-A049580] N78-21163
Heavy lift helicopter flight control system. Volume 3: Automatic flight control system development and feasibility demonstration
[AD-A050059] N78-21164
HEISENBERG THEORY
Quasiclassical methods in the linear Heisenberg model
N78-21940
HELICAL ANTENNAS
Design of two high gain, low profile helical antennas for operation at 918 MHz
[AD-A049950] N78-21386
HELICOPTERS
A life cycle cost study of contractor versus organic support of aircraft programs
[AD-A049438] N78-21045
Research requirements to improve reliability of civil helicopters
[NASA-CR-145335] N78-21093
Optimal control theory [OWEM] applied to a helicopter in the hover and approach phase
[NASA-CR-152135] N78-21161
HF radiation characteristics of the RH-53D helicopter and the Mark 105 AMCM system
[AD-A049795] N78-21358
HELIUM
Helium: A public policy problem
[PB-276040/3] N78-21585
Characterization of surfaces by low energy helium scattering
N78-21941
HELIUM ISOTOPES
X-ray diffraction studies of helium four
N78-21226
Cryogenic-coolant He-4-superconductor interaction
[NASA-CR-2963] N78-21406
Static and dynamic textures in superfluid He-3 --- Landau-Ginzburg equations
N78-21954
HELMETS
Helmet cold conditioning: Correlation of structural temperatures in actual and simulated cold environments
[AD-A050033] N78-21769
HERMETIC SEALS
Manufacturing methods and technology for hermetically sealed lithium SO2 cell batteries
[AD-A049943] N78-21617
HERMITIAN POLYNOMIAL
Asymptotic distribution of symmetric statistics
[AD-A049395] N78-21862
HETERODYNING
Tunable diode laser heterodyne spectrometer for balloon-borne solar radiometry in the stratosphere
[SAND-77-0601] N78-21463
HEURISTIC METHODS
A further investigation of efficient heuristic procedures for integer linear programming with an interior
[AD-A049593] N78-21804
HF LASERS
Materials for high-temperature hydrogen-fluorine environments
[Y/DA-7477] N78-21217
HIGH ALTITUDE
High altitude limit of the gradient drift instability
[AD-A049503] N78-21698

HIGH ALTITUDE BALLOONS
Test and development of inflatable spheres instrumented with miniaturized thermistors, accelerometers and pressure transducers
[NASA-CR-2968] N78-21428
HIGH ENERGY INTERACTIONS
High thermal efficiency, radiation-based advanced fusion reactors
[EPRI-ER-544] N78-21926
HIGH ENERGY PROPELLANTS
High energy halogen chemistry --- propellants and explosives
[AD-A049555] N78-21240
HIGH FREQUENCIES
HF radiation characteristics of the RH-53D helicopter and the Mark 105 AMCM system
[AD-A049795] N78-21358
HIGH GAIN
Design of two high gain, low profile helical antennas for operation at 918 MHz
[AD-A049950] N78-21386
HIGH PRESSURE
Use of leaning vanes in a two stage fan
[NASA-CR-152134] N78-21115
Test evaluation of stationary and rotating diffusers for a high pressure ratio radial compressor
[AD-A049856] N78-21474
High-pressure studies of soft mode transitions in solids
[SAND-77-1188C] N78-21968
HIGH RESOLUTION
Recent advances in high resolution inertial navigation
N78-21075
An analysis of multi-frequency high resolution radar rain rate data
[NASA-CR-156734] N78-21337
High-resolution spectroscopy using tunable diode lasers: Techniques and applications
[LA-UR-77-2222] N78-21917
HIGH STRENGTH STEELS
The influence of retained austenite on the thick section mechanical properties of a commercial low alloy ultra-high strength steel
N78-21254
HIGH TEMPERATURE
High temperature problems in gas turbine engines
[AGARD-CP-229] N78-21118
Technical evaluation report on 50th Propulsion and Energetics Panel Meeting on High Temperature Problems in Gas Turbine Engines
N78-21119
Practical solutions to the cooling of combustors operating at high temperatures
N78-21135
High temperature corrosion of Ni-base for turbine blades alloys in sulphate-chloride containing environments
N78-21140
Emission spectrum of the NU3 band of SF6 at 1780K
[AD-A049865] N78-21242
Determination of sound velocity in liquid metals at temperatures above 4000 K
[UCRL-79322-REV-1] N78-21285
HIGH TEMPERATURE ENVIRONMENTS
Problems concerning high temperatures in small turbomachines
N78-21121
Adapting a turbine engine test stand for high temperature research
N78-21124
Measuring techniques in high temperature turbines
N78-21151
Working in a hot environment; perspiration loss; a drink for persons working under hot conditions, part 2
[NASA-TM-75285] N78-21751
HIGH TEMPERATURE GASES
High Temperature Turbine Technology Program. Phase 1: Program and system definition. Topical report: Low BTU gas combustor technology development plan
[FE-2290-26] N78-21480
HIGH TEMPERATURE TESTS
Adapting a turbine engine test stand for high temperature research
N78-21124
A study of the effect of carbon upon the elevated temperature mechanical, fracture and static load crack extension behavior of austenitic stainless steel
N78-21255
HIGH VOLTAGES
Investigation of high voltage spacecraft system interactions with plasma environments
[NASA-TM-78831] N78-21373
HIGHWAYS
The use of satellite imagery for highway engineering in overseas countries
[PB-276669/9] N78-21328
Evaluation of noise nuisance: A study of willingness to receive payment for noise introduced into the home
[PB-276418/1] N78-21658
HILBERT SPACE
On Nth roots of positive operators
[NASA-CR-151697] N78-21841
Decomposition theorems for differential forms on Hilbert spaces
N78-21885
HISTOGRAMS
Iterative histogram modification, 2
[AD-A049588] N78-21801
Clustering edge values for threshold selection
[AD-A049592] N78-21823
HOLE DISTRIBUTION (MECHANICS)
On the question of equivalent reinforcement of holes in a shell --- using elastically deformed reinforcement rings
N78-21496
HOLLOW CATHODES
Pulse ignition characterization of mercury ion thruster hollow cathode using an improved pulse ignitor
[NASA-TM-78858] N78-21203
Effect of anode-cathode geometry on performance of the HIP-1 hot ion plasma --- magnetic mirrors
[NASA-TP-1201] N78-21922
HOLOGRAPHY
Long-range holography field experiments
[AD-A050122] N78-21433
HOT-FILM ANEMOMETERS
Analysis of temperature compensating circuits for hot-wires and hot-films
[AD-A050080] N78-21432
HOT-WIRE ANEMOMETERS
Analysis of temperature compensating circuits for hot-wires and hot-films
[AD-A050080] N78-21432
HOVERING STABILITY
Optimal control theory (OWEM) applied to a helicopter in the hover and approach phase
[NASA-CR-152135] N78-21161
HUMAN FACTORS ENGINEERING
Regional energetic coupling of man and his environment: Data requirements --- regional planning and ecosystems
N78-21543
Human performance in aviation systems
[AD-A050078] N78-21771
The measurement of cooperation and the determination of causal variables for cooperation in a technical environment
N78-21969
Morphology of design of aerospace systems with inclusion of human factors
[AD-A049999] N78-21973
HUMAN PERFORMANCE
Activation and sustained attention: A pupillometric study of an auditory vigilance task
[AD-A050040] N78-21759
Notes for a model of human performance in ZOG
[AD-A049532] N78-21783
HUMAN REACTIONS
The comprehension factor in randomized response
N78-21869
HURRICANES
Response of the upper ocean to Hurricane Eloise
[AD-A050245] N78-21722
A method for assessment of the natural variability found in hurricanes through use of ranking techniques and nonparametric statistics
[PB-276430/6] N78-21733
HYDRAULIC ANALOGIES
Hydraulic model of the Chesapeake Bay
N78-21539
HYDRAULIC EQUIPMENT
Development of a unified approach to the simulation of static and dynamic behavior of large mobile hydraulic systems
N78-21395
Digital computer simulation of the mechanical and thermal response of complex hydraulic systems
N78-21396
HYDROCARBON COMBUSTION
Fundamental and semi-global kinetic mechanisms of hydrocarbon combustion
[COO/4272-1] N78-21245
HYDROCARBON FUELS
Alternative fuels for transportation: Implications of the broad-cut option
[UCRL-52313] N78-21322
HYDROCARBONS
The use of halons as fire suppressants: A literature survey
[AD-A050098] N78-21237
Oxidation kinetics of hydrocarbon fuels
[AD-A050056] N78-21311
Vacuum ultraviolet and visible radiation from electron impact excitation of nitrogen, hydrogen, oxygen, the light hydrocarbons and the rare gases
N78-21897
HYDRODYNAMICS
Problems of hydrodynamics and heat exchange
[NASA-TT-F-17060] N78-21409
HYDROGEN FUELS
Evaluation of the use of hydrogen as a supplement to natural gas
[TID-27747] N78-21323
HYDROGEN ISOTOPES
Four Workshops in Alternate Concepts in Controlled Fusion. Part A: Executive summaries. Part B: Extended summaries. Part C: CTR using the p-B-11 reaction
[EPRI-ER-429-SR-PT-A] N78-21927
HYDROGEOLOGY
Aquifer test analyses for the Floridan aquifer in Flagler, Putnam, and St. Johns counties, Florida
[PB-275790/4] N78-21583
HYDROLOGY
An integrated study of earth resources in the state of California using remote sensing techniques
[E78-10115] N78-21520
Investigation of the application of HCMM thermal data to snow hydrology
[E78-10116] N78-21521
Snow parameters from Nimbus-6 electrically scanned microwave radiometer --- [ESMR-6]
[NASA-CR-156725] N78-21572
Water resources data for Washington, water year 1976. Volume 1: Western Washington
[PB-275886/0] N78-21581
Water resources data for Washington, water year 1976. Volume 2: Eastern Washington
[PB-275887/8] N78-21582
Water resources data for California, water year 1976. Volume 3: Southern central valley basins, and the great basin from Walker River to Truckee River
[PB-276354/8] N78-21586
HYDROMETEOROLOGY
Orographic precipitation model for hydrometeorological use
N78-21714
HYPERBOLIC FUNCTIONS
Boundary-dependent stability criteria for difference approximations of hyperbolic problems, I
[AD-A049501] N78-21846
HYPERSONIC FLOW
Laminar boundary layer stability measurements at Mach 7 including wall temperature effects --- conical bodies
[AD-A049535] N78-21415
HYPERSONIC WAKES
Study of the ablative effects on tektites: Atmosphere entry of a swarm of tektites --- shielding by hypersonic wake
[NASA-CR-156733] N78-22007

I

ICE
Metric remote sensing experiments in preparation for Spacelab flights --- alpine geomorphology and ice and/or snow cover
[NASA-TM-75093] N78-21571
ICE FORMATION
Lake Erie ice: Winter 1975 - 1976
[PB-276386/0] N78-21584
IGNITION
Anisothermal oxidation of titanium and its alloy
[AD-A050053] N78-21281
IGNITION SYSTEMS
Pulse ignition characterization of mercury ion thruster hollow cathode using an improved pulse ignitor
[NASA-TM-78858] N78-21203
IMAGE ENHANCEMENT
Automated image enhancement techniques for second generation FLIR
[AD-A049564] N78-21913
IMAGE PROCESSING
Unstructured control and communication processes in real world scene analysis
[AD-A049458] N78-21352
Chemical array studies
[AD-A050024] N78-21577
Interactive aids for cartography and photo interpretation
[AD-A049768] N78-21578
A survey of computer architectures for image processing and pattern recognition
[AD-A049536] N78-21784
PDP 11 image processing software
[AD-A049586] N78-21799
Thinning algorithms for grayscale pictures
[AD-A049587] N78-21800
Iterative histogram modification, 2
[AD-A049588] N78-21801
A note on the use of local MIN and MAX operations in digital picture processing
[AD-A049589] N78-21802
Algorithms and hardware technology image recognition
[AD-A049590] N78-21803
Clustering edge values for threshold selection
[AD-A049592] N78-21823
Digital imagery test set
[AD-A049798] N78-21825
Mosaic models for image analysis and synthesis
[AD-A050100] N78-21826
Automated image enhancement techniques for second generation FLIR
[AD-A049564] N78-21913

Quantitative determination of surface temperatures using an infrared camera
[CONF-770868-2] N78-21916
IMAGERY
Synthetic Aperture Radar [SAR] data processing N78-21567
An incoherent optical implementation of the two-dimensional Walsh transform N78-21911
IMAGES
How big the moon, how fat the eye?
[AD-A050211] N78-21756
IMAGING TECHNIQUES
Long-range holography field experiments
[AD-A050122] N78-21433
Study of soft alkaline using LANDSAT images of pools and residue with an emphasis on radioactive materials --- Brazil
[E78-10104] N78-21510
Hard X-ray imaging facility for space shuttle: A scientific and conceptual engineering study
[NASA-CR-156736] N78-22016
IMPACT TESTS
Helmet cold conditioning: Correlation of structural temperatures in actual and simulated cold environments
[AD-A050033] N78-21769
IMPURITIES
Effects of impurities on shock wave stability and structure in ionizing monatomic gases
[UTIAS-TN-212] N78-21405
Broadness of optical impurity spectra in the solid state N78-21899
Tokamak impurity instabilities
[ERDA-TR-314] N78-21934
IN-FLIGHT MONITORING
Report on aircraft fatigue studies --- in-flight monitoring and stress measurements
[AD-A049876] N78-21102
INCIDENT RADIATION
Internal reflection of bounded beams: Effects in the plane of incidence N78-21910
INDEXES [DOCUMENTATION]
Analysis of global oceanic rainfall from microwave data
[NASA-CR-156737] N78-21719
INDIA
Application of wheat yield model to United States and India --- Great Plains
[E78-10109] N78-21515
INDIUM
Intrinsic fluctuation of thin film microbridges N78-21947
INDIUM ANTIMONIDES
Generation and detection of microwave phonons in N-type indium antimonide N78-21945
INDUSTRIAL ENERGY
Fuel and energy price forecasts: Quantities and long-term marginal prices, volume 1
[EPRI-EA-433-VOL-1] N78-21637
Energy oriented study of industrial cyclone separators
[TREE-1174] N78-21642
INDUSTRIAL PLANTS
Progress toward a circulation atlas for application to coastal water siting problems
[VIMS-CONTRIB-823] N78-21560
Century industrial products FRP-100 wet scrubber evaluation --- for air pollution control
[PB-276520/4] N78-21680
INDUSTRIES
Annual survey of manufactures, 1975. Fuels and electric energy consumed. Statistics for the United States
[PB-275772/2] N78-21659
INELASTIC SCATTERING
Improved calculations of X-ray and inelastic electron scattering Compton profiles
[AD-A049513] N78-21960
INERTIAL NAVIGATION
Sandia inertial terrain-aided navigation system
[SAND-77-0521] N78-21070
Future applications of low cost strapdown laser inertial navigation systems N78-21072
New techniques for low cost strapdown inertial systems N78-21073
Recent advances in high resolution inertial navigation N78-21075
Calibration of an IRS based on flight data N78-21076
INFINITY
Stability of an infinite system of differential equations N78-21833
INFORMATION DISSEMINATION
A computerized log for Systems and Cost Analysis Division Cost Estimate Control Data Center [CECDC] validation activity
[AD-A049976] N78-21984
Incentives for the generation, dissemination and use of scientific and technical information
[PB-276180/7] N78-21985
INFORMATION RETRIEVAL
Some problems in assessing oculomotor activity during information retrieval N78-21763
INFORMATION SYSTEMS
Forest resource information system
[E78-10114] N78-21519
Maryland Automated Geographic Information System N78-21534
Development and application of data processing and pattern recognition methods
[AD-A049846] N78-21982
Incentives for the generation, dissemination and use of scientific and technical information
[PB-276180/7] N78-21985
Decision making with interactive access to integrated administrative and technological data bases. An illustrated conceptual overview --- energy storage
[UCRL-80353] N78-21986
Conference report to the National Science Foundation on the NFAIS/ASIDIC/EUSIDIC/ICSUAB Meeting on Bibliographic Control
[PB-275791/2] N78-21988
INFORMATION THEORY
Communications high-order language investigation, volume 1
[AD-A049737] N78-21340
Communications high-order language investigation, volume 2
[AD-A049736] N78-21341
Axiomatic characterization of a family of information measures that contains the directed divergences
[AD-A050096] N78-21983
INFRARED ASTRONOMY
Continued development of doped-germanium photoconductors for astronomical observations at wavelengths from 30 to 120 micrometers
[NASA-CR-152125] N78-22000
INFRARED DETECTORS
Comparison of the 3-5 micrometer and 8-12 micrometer regions for advanced thermal imaging systems: LOWTRAN revisited
[AD-A049448] N78-21697
Electron beam addressed arrays of infrared bolometers
[AD-A049550] N78-21905
INFRARED IMAGERY
Automated image enhancement techniques for second generation FLIR
[AD-A049564] N78-21913
INFRARED LASERS
High-resolution spectroscopy using tunable diode lasers: Techniques and applications
[LA-UR-77-2222] N78-21917
INFRARED PHOTOGRAPHY
Quantitative determination of surface temperatures using an infrared camera
[CONF-770868-2] N78-21916
INFRARED RADIATION
Anomalous infrared emission from condensing and cooling steam clouds
[AD-A050083] N78-21914
INFRARED RADIOMETERS
Severe storms observing satellite [STORMSAT]
[NASA-CR-156735] N78-21720
INFRARED SPECTRA
Laboratory simulation of infrared astrophysical features --- silicate mixtures with emission spectra matching those of comets N78-21998
INFRARED WINDOWS
Comparison of the 3-5 micrometer and 8-12 micrometer regions for advanced thermal imaging systems: LOWTRAN revisited
[AD-A049448] N78-21697
INITIATION
Initiation mechanisms of solid rocket propellant detonation
[AD-A049531] N78-21305
INJECTION LASERS
Optical-microwave interactions in semiconductor devices
[AD-A050480] N78-21458
INJECTORS
Photographic characterization of spark-ignition engine fuel injectors
[NASA-TM-78830] N78-21110
INLET FLOW
Theoretical flow characteristics of inlets for tilting-nacelle VTOL aircraft
[NASA-TP-1205] N78-21114
INPUT/OUTPUT ROUTINES
A three-dimensional potential-flow program with a geometry package for input data generation
[NASA-CR-145311] N78-21047
A control system for depicting information from computer on an electroluminophoric plate
[AD-A049394] N78-21788
INSOLATION
Energy conservation via solar energy application to multi-family and commercial structures. Volume 2, part 2: Solar energy atlas for New York state
[PB-276130/2] N78-21618
INSTRUMENT LANDING SYSTEMS
Inertial smoothing and extrapolation of ILS beams: Application to the Airbus A 300 B N78-21074
INTAKE SYSTEMS
A brief examination of the flow external to an F-111 intake at Mach 1.6
[ARL/ME-NOTE-357] N78-21054
Comparison of the noise characteristics of two low pressure ratio fans with a high throat Mach number inlet
[NASA-TM-73880] N78-21108
A small gas inlet system for orbital mass-spectrometer calibrations
[NASA-TP-1170] N78-21430
INTEGERS
Multicriteria integer zero-one programming: A tree-search type algorithm
[AD-A050244] N78-21807
INTEGRAL EQUATIONS
Systems of generalized Abel integral equations with applications to simultaneous dual relations
[AD-A049446] N78-21844
Systems of generalized Abel integral equations
[AD-A050001] N78-21857
INTEGRATED CIRCUITS
High-reliability, low-cost integrated circuits
[AD-A049763] N78-21383
Radiation characterization of sequential logic circuits
[AD-A050476] N78-21388
INTEGRATED OPTICS
Diffusion process for formation of single-mode waveguide
[AD-A049558] N78-21915
INTEGRITY
Performances assurance and data integrity practices
[PB-276400/9] N78-21819
INTERFACIAL ENERGY
Friction and metal transfer for single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1191] N78-21294
INTERFERENCE DRAG
A brief examination of the flow external to an F-111 intake at Mach 1.6
[ARL/ME-NOTE-357] N78-21054
INTERMETALLICS
Structural and magnetic studies of selected rare earth intermetallics N78-21949
INTERNAL WAVES
Internal gravity wave generation by vortex wakes
[AD-A049515] N78-21699
INTERNATIONAL COOPERATION
Space orbits of collaboration --- international cooperation and the U.S.S.R. space program
[NASA-TM-75096] N78-21176
INTERSTELLAR TRAVEL
An interstellar precursor mission
[NASA-CR-156152] N78-21173
INVENTORY CONTROLS
Economies available through improved inventory management
[PB-276048/6] N78-21977
INVENTORY MANAGEMENT
Helium: A public policy problem
[PB-276040/3] N78-21585
ION BEAMS
A scanning ion microscope with a field ionization source N78-21909
ION EMISSION
A scanning ion microscope with a field ionization source N78-21909
ION IMPLANTATION
A feasibility study of ion implantation techniques for mass spectrometer calibration
[NASA-TP-1185] N78-21431
ION MICROSCOPES
A scanning ion microscope with a field ionization source N78-21909
ION PROPULSION
Evolution of the 1-mlb mercury ion thruster subsystem
[NASA-TM-73733] N78-21202
Planned flight test of a mercury ion auxiliary propulsion system. 1: Objectives, systems descriptions, and mission operations
[NASA-TM-78859] N78-21204
Effect of facility background gases on internal erosion of the 30-cm Hg ion thruster
[NASA-TM-73803] N78-21205
A review of electron bombardment thruster systems/spacecraft field and particle interfaces
[NASA-TM-78850] N78-21206
Diagnostic evaluations of a beam-shielded 8-cm mercury ion thruster
[NASA-TM-78855] N78-21207

ION SELECTIVE ELECTRODES
Application and theoretical studies of silver and mercuric sulfide-based ion selective electrodes
N78-21369
ION TEMPERATURE
Effect of anode-cathode geometry on performance of the HIP-1 hot ion plasma --- magnetic mirrors
[NASA-TP-1201] N78-21922
IONIC COLLISIONS
Experimental and theoretical studies of ion-molecule scattering
N78-21898
IONIZATION
A scanning ion microscope with a field ionization source
N78-21909
IONOSPHERIC DISTURBANCES
A study of the Peninsula Method for the controlled artificial generation of ULF waves in the ionosphere and magnetosphere
[AD-A049514] N78-21354
IONOSPHERIC PROPAGATION
Antenna selection for ionospheric telecommunication systems
[AD-A049549] N78-21364
Ionospheric reflection and absorption properties of normal modes at ELF
[AD-A049778] N78-21702
IONOSPHERICS
Ionospheric effects on the Doppler frequency shift in SARSAT propagation
[CRC-1313] N78-21334
IRIDIUM
Chemisorption and reaction mechanisms on iron and iridium surfaces
N78-21955
IRON
An investigation of the influence of shock-wave profile on the mechanical and thermal responses of polycrystalline iron
[AD-A049764] N78-21278
Chemisorption and reaction mechanisms on iron and iridium surfaces
N78-21955
IRON ALLOYS
Influence of metal variables on the structure and properties of heavy section ductile iron
N78-21253
Alloy corrosion-fundamental studies of dissolution and passivity of alloys and compounds
[AD-A049848] N78-21273
ISENTROPIC PROCESSES
Identification and tracing of water masses with an application near the Galapagos Islands
N78-21736
ISOMORPHISM
Quasiclassical methods in the linear Heisenberg model
N78-21940
ISOTHERMAL PROCESSES
Systematic studies of heat transfer and film cooling effectiveness
N78-21146
ISOTOPES
General-purpose heat source project, space nuclear safety program, and radioisotopic terrestrial safety program
[LA-7003-PR] N78-21906
ITALY
Metric remote sensing experiments in preparation for Spacelab flights --- alpine geomorphology and ice and/or snow cover
[NASA-TM-75093] N78-21571

J

JET AIRCRAFT
Factors affecting the retirement of commercial transport jet aircraft
[NASA-CR-152115] N78-21092
JET EXHAUST
The influence of jets of cooling air exhausted from the trailing edges of a supercritical turbine cascade on the aerodynamic data
N78-21148
JET FLOW
Experimental investigation of effect of jet decay rate on jet-induced pressures on a flat plate
[NASA-CR-2979] N78-21096
JET MIXING FLOW
Effect of turbulent jet mixing on the static lift performance of a power augmented ram wing
[AD-A049620] N78-21060
JOINTS (JUNCTIONS)
Development of a ceramic tube heat exchanger with relaxing joint
[FE-2556-06] N78-21423
JOSEPHSON JUNCTIONS
Performance limits of a Josephson junction mixer
[AD-A049544] N78-21963
JOURNAL BEARINGS
Hydrodynamic air lubricated compliant surface bearing for an automotive gas turbine engine. 1: Journal bearing performance
[NASA-CR-135368] N78-21472

K

KALMAN FILTERS
Development of the integrated all-weather navigation system for tornado [MRCA]
N78-21089
Solutions to the Kalman filter wordlength problem: Square root and U-D covariance factorizations
[AD-A049704] N78-21854
KANSAS
Estimated winter wheat yield from crop growth predicted by LANDSAT --- Kansas
[E78-10112] N78-21517
KINEMATICS
A general approach for kinematic waves
[AD-A050077] N78-21367
A study of the characteristics of the data systems test kinematic fields
[AD-A050060] N78-21721
KINETIC EQUATIONS
Kinetics of model chemical reactions
N78-21894
KINETIC THEORY
A general approach for kinematic waves
[AD-A050077] N78-21367
KINETICS
A fracture mechanics analysis of the kinetics of stress-corrosion crack growth in a high-strength 12Ni-5Cr-3Mo maraging steel
N78-21256
Thermochemical and kinetic data of gaseous metal oxides and their relationship to atmospheric composition
[AD-A050162] N78-21700
Prospects for studying gas chemisorption kinetics using current fluctuations
N78-21953
KLYSTRONS
Klystron-twt hybrid efficiency improvement
[AD-A050125] N78-21377

L

LABORATORIES
Laboratory automatic data acquisition system
[BDX-613-1566] N78-21435
LAGRANGIAN EQUILIBRIUM POINTS
Relativistic neutron gas interacting through a spin 2 field and its astrophysical applications
N78-22004
LAKE ERIE
Lake Erie ice: Winter 1975 - 1976
[PB-276386/0] N78-21584
LAKE ICE
Lake Erie ice: Winter 1975 - 1976
[PB-276386/0] N78-21584
LAKE ONTARIO
Coastal wetlands along Lake Ontario and the St. Lawrence in Jefferson County, New York
[PB-276031/2] N78-21744
LAMINAR BOUNDARY LAYER
Flow of viscous gas in the region of a slot with strong suction
[NASA-TM-75241] N78-21411
Experimental study of the laminar-turbulent transition of a concave wall in a parallel flow
[NASA-TM-75243] N78-21412
Laminar boundary layer stability measurements at Mach 7 including wall temperature effects --- conical bodies
[AD-A049535] N78-21415
A numerical investigation of the boundary layer of an atmospheric mesoscale vortex
N78-21688
LAMINAR FLOW
Laminar film condensation of a liquid metal in a vertical channel with variations in wall temperature
N78-21397
LAMINATES
Evaluation and expansion of an analytical model for fatigue of notched composite laminates
[NASA-CR-145308] N78-21219
In situ ply strength: An initial assessment --- using laminate fracture data and a least squares method
[NASA-TM-73771] N78-21220
Titanium/beryllium laminates: Fabrication, mechanical properties, and potential aerospace applications
[NASA-TM-73891] N78-21221
Fatigue in adhesively bonded laminates --- aluminum alloy laminates
[AD-A049529] N78-21271
Simple torsion test for shear moduli determination of orthotropic composites
[NASA-TM-78485] N78-21490
LANCE MISSILE
The 12829C Lance missile no. 4236, round no. 299 RSL, 25 August 1977
[AD-A049435] N78-21726
The 14821A Lance missile no. 3294, round no. 301 APL, 5 October 1977
[AD-A049431] N78-21727
LAND USE
An integrated study of earth resources in the state of California using remote sensing techniques
[E78-10115] N78-21520
Inventory of forest resources [including water] by multi-level sampling --- nine northern Virginia coastal plain counties
[E78-10118] N78-21522
Remote sensing, geology, and land use
N78-21533
Relationship of land use to water quality in the Chesapeake Bay region --- water sampling and photomapping river basins
N78-21544
Role of remote sensing in documenting land use as it affects the Bay and Bay use as it affects the land
N78-21556
Planner's energy workbook: A manual for exploring relationships between land use and energy utilization
[BNL-50633] N78-21634
Distributed technologies in California's energy future: A preliminary report, volume 2
[LBL-6831-VOL-2] N78-21635
LANDAU FACTOR
The Landau problem for motions on curves
[AD-A049492] N78-21828
LANDAU-GINZBURG EQUATIONS
Static and dynamic textures in superfluid He-3 --- Landau-Ginzburg equations
N78-21954
LANDING AIDS
Precise enroute navigation based on ground-derived techniques
N78-21078
Definition of tire properties required for landing system analysis
[NASA-CR-156171] N78-21326
LANDSAT FOLLOW-ON MISSIONS
Evaluation of LANDSAT MSS vs TM simulated data for distinguishing hydrothermal alteration
[NASA-CR-156168] N78-21569
LANDSAT SATELLITES
Present status of LANDSAT remote sensing
N78-21529
LANDSAT and other sensor data for land-use planning in the Baltimore area
N78-21532
LANDSAT sensors
N78-21540
The use of LANDSAT digital data and computer-implemented techniques for an agricultural application
[NASA-RP-1016] N78-21568
LANTHANUM ALLOYS
Superconductivity, spin-glass properties, and ferromagnetism in amorphous La-Gd-Au alloys
N78-21951
LAPLACE TRANSFORMATION
LAPAC: A computer package for solving the Laplace transform
N78-21837
Theory and simulation of the stability of Bernstein-Greene-Kruskal waves --- vlasov equations and laplace transformation
N78-21918
LARGE SPACE STRUCTURES
Construction in space: A proposed experiment in support of the space solar power concept and other large space systems
[NASA-TM-79435] N78-21179
LARGE SPACE TELESCOPE
Research directed toward improved echelles for the ultraviolet --- large space teslescope spectrographs
[NASA-CR-156732] N78-21427
LASER ALTIMETERS
Engineering study for pallet adapting the Apollo laser altimeter and photographic camera system for the Lidar Test Experiment on orbital flight tests 2 and 4
[NASA-CR-152615] N78-21525
LASER APPLICATIONS
A review of the thermoelectronic laser energy converter [TELEC] program at Lewis Research Center
[NASA-TM-73888] N78-21441
Optically pumped mercury lasers for ring laser gyroscope applications
[AD-A049540] N78-21455
High-resolution spectroscopy using tunable diode lasers: Techniques and applications
[LA-UR-77-2222] N78-21917
LASER DAMAGE
Laser hazards bibliography, August 1977 eighth edition
[AD-A047606] N78-21457
An investigation of laser interactions
[AD-A050049] N78-21460
Biological applications and effects of optical masers
[AD-A050057] N78-21462

LASER DOPPLER VELOCIMETERS
Correlation of laser velocimeter measurements over a wing with results of two prediction techniques --- in the Langley V/STOL tunnel
[NASA-TP-1168] N78-21410

LASER FUSION
High energy ion expansion in laser-plasma interactions
[AD-A049504] N78-21446
Laser-fusion studies at NRL: A report to ERDA
[AD-A050089] N78-21451

LASER HEATING
Space electric power design study --- laser energy conversion
[NASA-CR-152031] N78-21590

LASER MODE LOCKING
Optically pumped mercury lasers for ring laser gyroscope applications
[AD-A049540] N78-21455

LASER OUTPUTS
High energy ion expansion in laser-plasma interactions
[AD-A049504] N78-21446
Experimental study of the initiation mechanism of laser supported absorption waves
[AD-A050054] N78-21461

LASER PUMPING
Generation of coherent VUV and soft X-rays
[AD-A049858] N78-21450
Energy storage and two-photon extraction from metastable states
[AD-A050075] N78-21459

LASER RANGE FINDERS
Synthesis and analysis of precise spaceborne laser ranging systems, volume 1 --- link analysis
[NASA-CR-156727] N78-21442
Synthesis and analysis of precise spaceborne laser ranging systems, volume 2 --- Spacelab payload
[NASA-CR-156728] N78-21443

LASERS
Runway roughness evaluation laser profilometer implementation study
[AD-A049440] N78-21165
Free electron laser theory
N78-21437
Optically pumped mercury laser for absolute frequency stabilization
N78-21440
Fundamental mechanisms of nonequilibrium MHD lasing phenomena
[AD-A049509] N78-21447
Lidar: A laser technique for remote sensing
N78-21549

LATTICES [MATHEMATICS]
Critical phenomena of inhomogeneous ising models
N78-21939

LAUNCH VEHICLES
An assessment of an F2 or N2O4 atmospheric injection from an aborted space shuttle mission
[NASA-CR-156164] N78-21664

LAUNCHING SITES
The 12829C Lance missile no. 4236, round no. 299 RSL, 25 August 1977
[AD-A049435] N78-21726
The 14821A Lance missile no. 3294, round no. 301 APL, 5 October 1977
[AD-A049431] N78-21727
The 14823A Lance missile no. 3293, round no. 300 AST 5 October 1977
[AD-A049430] N78-21728

LAW [JURISPRUDENCE]
Transcript of National Commission on New Technological uses of copyrighted works
[PB-275786/2] N78-21987

LEAD [METAL]
Thermophysical and transport properties of metals at high pressure and very high temperature
[UCRL-79586] N78-21286
Metallography of commercial lead and lead alloys used in the electricity supply industry
[PB-276437/1] N78-21287
Remote sensing applied to geological mapping; comparative geomorphology and identification of mineral zones of zinc and lead in the region of Vazante, MG --- Brazil
[E78-10108] N78-21514

LEAD ALLOYS
Metallography of commercial lead and lead alloys used in the electricity supply industry
[PB-276437/1] N78-21287

LEADING EDGE SLATS
Effect of leading-edge contour and vertical-tail configuration on the low-speed stability characteristics of a supersonic transport model having a highly-swept arrow wing
[NASA-TM-78683] N78-21051

LEAKAGE
Stored charge release in cables in low fluence X-ray environments
[AD-A050112] N78-21376
Aquifer test analyses for the Floridan aquifer in Flagler, Putnam, and St. Johns counties, Florida
[PB-275790/4] N78-21583

LEARNING CURVES
A computer program for solving learning curve problems
[AD-A049917] N78-21812

LEAST SQUARES METHOD
In situ ply strength: An initial assessment --- using laminate fracture data and a least squares method
[NASA-TM-73771] N78-21220

LEAVES
Estimated winter wheat yield from crop growth predicted by LANDSAT --- Kansas
[E78-10112] N78-21517

LIAPUNOV FUNCTIONS
A Liapunov functional for a matrix neutral difference-differential equation with one delay
[AD-A049868] N78-21859

LIBRARIES
Transcript of National Commission on New Technological uses of copyrighted works
[PB-275786/2] N78-21987

LIE GROUPS
A character formula for the discrete series of a semisimple lie group
N78-21886

LIFE [DURABILITY]
Trends of future turbine life prediction: Time phase automated analysis and test verification
N78-21143
An interstellar precursor mission
[NASA-CR-156152] N78-21173

LIFE CYCLE COSTS
Fiber Optics Cost Analysis Program [FOCAP]
[AD-A049859] N78-21105
Training device design: The simulation/ stimulation controversy
[AD-A049973] N78-21169
IEMCAP implementation study, volume 1
[AD-A049739] N78-21344

LIFE SUPPORT SYSTEMS
Dynamic hyperfiltration membranes for high-temperature spacecraft wash water recycle
[NASA-CR-151689] N78-21767

LIFT
Unsteady, surface pressure and near-wave hotwire measurements of a circulation control airfoil
[AD-A050025] N78-21061

LIFT AUGMENTATION
Effect of turbulent jet mixing on the static lift performance of a power augmented ram wing
[AD-A049620] N78-21060

LIFT DEVICES
Effect of high lift flap systems on the conceptual design of a 1985 short-haul commercial STOL tilt rotor transport
[NASA-TM-78474] N78-21094

LIGHT [VISIBLE RADIATION]
Vacuum ultraviolet and visible radiation from electron impact excitation of nitrogen, hydrogen, oxygen, the light hydrocarbons and the rare gases
N78-21897

LIGHT CURVE
On the theory and analysis of occultation light curves
N78-22005

LIGHT SCATTERING
Investigation of the surface roughness of evaporated copper films by optical scattering
N78-21252
Light scattering and Brownian motion
N78-21912

LIGHT SOURCES
Generation of coherent VUV and soft X-rays
[AD-A049858] N78-21450

LIGHT TRANSMISSION
Data compendium for atmospheric laser propagation studies conducted at Cape Canaveral, Florida, February - May 1977
[AD-A050094] N78-21452
Comparison of the 3-5 micrometer and 8-12 micrometer regions for advanced thermal imaging systems: LOWTRAN revisited
[AD-A049448] N78-21697

LIMITER CIRCUITS
Fuel pressure increase limiter
[AD-A049393] N78-21117
Controlled impedance short circuit limiter
[EPRI-EL-537] N78-21392

LINE SPECTRA
Study of diatomic molecules. 2: Intensities --- optical emission spectroscopy of ScO
[NASA-TM-75290] N78-21900
Spectrophotometric investigations of white dwarf stars
N78-21994
Analysis of EUV solar line profiles of Si-2 and Si-3
N78-22009

LINEAR EQUATIONS
Theory and simulation of the stability of Bernstein-Greene-Kruskal waves --- vlasov equations and laplace transformation
N78-21918

LINEAR PROGRAMMING
A hybrid approach to multi-stage linear programs
[AD-A049477] N78-21798
A further investigation of efficient heuristic procedures for integer linear programming with an interior
[AD-A049593] N78-21804

LINEAR SYSTEMS
A new approach to computer aided transient analysis of stiff linear networks
N78-21818
Global controllability for a class of bilinear systems
[AD-A049518] N78-21882
A modified quadratic cost problem and feedback stabilization of linear discrete time systems
[AD-A049519] N78-21883
On feedback stabilization of time varying discrete linear systems
[AD-A049530] N78-21884

LINEARIZATION
Role of statistical linearization in the solution of nonlinear stochastic equations
[UCRL-80094] N78-21867

LINES [GEOMETRY]
Analytical determination of the Burmester lines for cylindric-cylindric cranks
N78-21465

LINKAGES
Analytical determination of the Burmester liaes for cylindric-cylindric cranks
N78-21465

LIQUID ALLOYS
Theory of amorphous CuNi alloys
N78-21250

LIQUID CRYSTALS
Nonlinear optical effects in liquid crystals
N78-21937

LIQUID HELIUM
Static and dynamic textures in superfluid He-3 --- Landau-Ginzburg equations
N78-21954

LIQUID METALS
Determination of sound velocity in liquid metals at temperatures above 4000 K
[UCRL-79322-REV-1] N78-21285

LIQUID PROPELLANT ROCKET ENGINES
Liquid rocket engine self-cooled combustion chambers
[NASA-SP-8124] N78-21211

LIQUID ROCKET PROPELLANTS
Combustion properties of high density fuels --- liquid rocket propellant combustion simulation using pneumatic equipment
[AD-A050051] N78-21310

LIQUID SLOSHING
Constrained sloshing of liquid mercury in a flexible spherical tank
[NASA-TM-78833] N78-21403

LIQUID SODIUM
Laminar film condensation of a liquid metal in a vertical channel with variations in wall temperature
N78-21397

LIQUIDS
On the tidal oscillations of the liquid core of the earth
[NASA-TP-1223] N78-21691

LITHIUM COMPOUNDS
Evaluation of lithium titanates as cathode materials
N78-21588

LITHIUM FLUORIDES
Binding energy and effectiveness mass of charged particles trapped on surfaces
[AD-A049945] N78-21964

LITHIUM ISOTOPES
Determination of boron and lithium by recording the products from [n, alpha] reactions
[NASA-TM-75260] N78-21904

LITHIUM OXIDES
Microstructure evolution during sintering of beta - alumina compositions
N78-21258

LOADING MOMENTS
Complex loading of a composite material with a plastic matrix by torsion and tension
N78-21222

LOADS [FORCES]
Bearingless tail rotor loads and stability
[AD-A049579] N78-21098
Experimental investigation of the effects of fluid loading on flexural waves in plates
[AD-A050020] N78-21417
The time to failure of cables subjected to random loads
[AD-A049585] N78-21498

LOGIC CIRCUITS
Radiation characterization of sequential logic circuits
[AD-A050476] N78-21388
A synthesis technique for the resolution of large scale fluid logic networks
N78-21400

LOGISTICS MANAGEMENT
Economies available through improved inventory management
[PB-276048/6] N78-21977

LONG WAVE RADIATION
Optical conversion processes
[AD-A049583] N78-21448

LONGITUDINAL CONTROL
Results from flight and simulator studies of a Mach 3 cruise longitudinal autopilot
[NASA-TP-1180] N78-21160
LOOP ANTENNAS
Analysis of thin-wire antennas in the presence of a dielectric and/or ferrite inhomogeneity
[AD-A049455] N78-21350
A study of the Peninsula Method for the controlled artificial generation of ULF waves in the ionosphere and magnetosphere
[AD-A049514] N78-21354
LOW COST
High-reliability, low-cost integrated circuits
[AD-A049763] N78-21383
Thin films of gallium arsenide on low-cost substrates
[SAN/1202-77/2] N78-21965
LOW DENSITY RESEARCH
Numerical simulations of collisionless drift instabilities for low-density plasmas
[PPPL-1382] N78-21930
LOW FREQUENCIES
Computation of groundwave attenuation over irregular and inhomogeneous ground at low and medium frequencies
[BBC-RD-1978/7] N78-21332
LUBRICANTS
Surface chemistry of fluoropolymer barrier films: Relation of solution variables to film properties
[AD-A050003] N78-21298
LUNAR BASES
Utilization of lunar materials and expertise for large scale operations in space: Abstracts --- lunar bases and space industrialization
[NASA-CR-156167] N78-21180
LUNAR MARIA
Apollo over the moon: A view from orbit
[NASA-SP-362] N78-21174
LUNAR PHOTOGRAPHY
Apollo over the moon: A view from orbit
[NASA-SP-362] N78-21174
LUNAR SOIL
Laboratory simulation of infrared astrophysical features --- silicate mixtures with emission spectra matching those of comets
N78-21998
LUNGS
Protection of the cardiopulmonary systems against the injurious effects of acceleration
[AD-A050142] N78-21755
LYMPHOCYTES
Separation of lymphocytes by electrophoresis under terrestrial conditions and at zero gravity, phase 3
[NASA-CR-151702] N78-21753

M

MACH NUMBER
Heat transfer to a PVD rotor blade at high subsonic passage throat Mach numbers
N78-21150
Results from flight and simulator studies of a Mach 3 cruise longitudinal autopilot
[NASA-TP-1180] N78-21160
MACHINE TOOLS
Flo-peeling and other alternatives to conventional turning
[AD-A050123] N78-21475
MACHINING
Flo-peeling and other alternatives to conventional turning
[AD-A050123] N78-21475
MAGNESIUM ALLOYS
Effects of thermo-mechanical processing on aluminum-magnesium alloys containing high weight percentage magnesium
[AD-A050092] N78-21275
MAGNETIC EQUATOR
On the average configuration of the geomagnetic tail
[NASA-TM-78116] N78-21695
MAGNETIC FIELDS
Design of an electrostatic end-plugged plasma-confinement device
[UCRL-79880] N78-21928
Effects of global field errors on ELMO Bumpy Torus
[ORNL/TM-6075] N78-21935
Theoretical studies of optical phenomena in solids
N78-21946
MAGNETIC INDUCTION
Transient analysis of a finite length cylindrical scatterer very near a perfectly conducting ground, part 1
[AD-A050143] N78-21342
MAGNETIC MATERIALS
Theory of large agglomerates in magnetic colloids
N78-21921
MAGNETIC MIRRORS
Effect of anode-cathode geometry on performance of the HIP-1 hot ion plasma --- magnetic mirrors
[NASA-TP-1201] N78-21922
MAGNETIC PROPERTIES
Structural and magnetic studies of selected rare earth intermetallics
N78-21949
MAGNETIC RESONANCE
Research investigation directed toward extending the useful range of the electromagnetic spectrum
[NASA-CR-156069] N78-21236
MAGNETIC STORMS
NASA charging analyzer program: A computer tool that can evaluate electrostatic contamination
[NASA-TM-73889] N78-21372
MAGNETOHYDRODYNAMIC GENERATORS
Study of some recent advances in the concept and design of MHD generators
[AEOI-26] N78-21662
MAGNETOHYDRODYNAMIC STABILITY
Self-stabilization of a high pressure plasma in toroidal containers with an arbitrary shape for the magnetic axis
[ERDA-TR-311] N78-21931
Induced oscillation instabilities and their role in Tokamaks with injected neutral particles
[ERDA-TR-312] N78-21932
Bounce effects in the instability theory of trapped alpha particles in the Tokamak reactor
[ERDA-TR-313] N78-21933
Effects of global field errors on ELMO Bumpy Torus
[ORNL/TM-6075] N78-21935
MAGNETOHYDRODYNAMICS
Fundamental mechanisms of nonequilibrium MHD lasing phenomena
[AD-A049509] N78-21447
MAGNETOSPHERE
A study of the Peninsula Method for the controlled artificial generation of ULF waves in the ionosphere and magnetosphere
[AD-A049514] N78-21354
MAINTAINABILITY
Unattended/minimally attended radar study, volume 2
[AD-A049777] N78-21347
MAINTENANCE
Development of a pavement maintenance management system. Volume 2: Airfield pavement distress identification manual
[AD-A049029] N78-21170
Multi-item scheduling in reparable item inventory systems with reflection programming
[AD-A049553] N78-21808
Algorithms for computing repair schedules in probabilistic environments
[AD-A049554] N78-21809
Group replacement of a multicomponent system which is subject to deterioration only
[AD-A049502] N78-21971
MAN MACHINE SYSTEMS
Adaptive training of perceptual motor skills: Issues, results and future directions
[AD-A050461] N78-21765
Visual-proprioceptive cue conflicts in the control of remotely piloted vehicles
[AD-A049706] N78-21770
Notes for a model of human performance in ZOG
[AD-A049532] N78-21783
Research in natural language understanding
[AD-A049781] N78-21810
MANAGEMENT
Group replacement of a multicomponent system which is subject to deterioration only
[AD-A049502] N78-21971
MANAGEMENT ANALYSIS
A range of cost measuring risk and uncertainty in major programs: An aid to decision making --- for federal funding
[PB-276384/5] N78-21979
MANAGEMENT INFORMATION SYSTEMS
Continued implementation and testing of a Neighborhood Office Center [NOC] and integration of the NOC with an administrative correspondence management information system
[NASA-CR-156150] N78-21970
MANAGEMENT METHODS
Summaries of conclusions and recommendations on the operations of civil departments and agencies
[PB-276094/0] N78-21976
MANAGEMENT PLANNING
IEMCAP implementation study, volume 1
[AD-A049739] N78-21344
Energy systems analysis and development
[BNL-22969] N78-21633
MANAGEMENT SYSTEMS
Group replacement of a multicomponent system which is subject to deterioration only
[AD-A049502] N78-21971
MANIPULATORS
Collision detection and avoidance in computer controlled manipulators
N78-21766
MANNED ORBITAL LABORATORIES
Laboratory in space --- Salyut-6 space station
N78-21185
MANNED SPACE FLIGHT
Dynamic hyperfiltration membranes for high-temperature spacecraft wash water recycle
[NASA-CR-151689] N78-21767
MANUALS
Effluent monitoring procedures: Metals analyses. Student reference manual
[PB-275391/1] N78-21674
Effluent monitoring procedures: Metals analyses. Staff guide for conducting the course
[PB-275393/7] N78-21675
MANUFACTURING
Design of interactive manufacturing and quality systems subject to inspection error using dynamic programming
N78-21481
Manufacturing methods and technology for hermetically sealed lithium SO2 cell batteries
[AD-A049943] N78-21617
MAPPING
Associative array processing of raster scanned data for automated cartography II: Improved resolution and data handling
[AD-A049698] N78-21379
Remote sensing applied to geological mapping; comparative geomorphology and identification of mineral zones of zinc and lead in the region of Vazante, MG --- Brazil
[E78-10108] N78-21514
Application of a computerized environmental information system to master and sector planning
N78-21561
Interactive aids for cartography and photo interpretation
[AD-A049768] N78-21578
Analysis of the bipole-dipole resistivity method for geothermal exploration
[LBL-6332] N78-21710
MARAGING STEELS
A fracture mechanics analysis of the kinetics of stress-corrosion crack growth in a high-strength 12Ni-5Cr-3Mo maraging steel
N78-21256
MARINE BIOLOGY
Inferring nutrient loading of estuarine systems by remote sensing of aquatic vegetation
N78-21552
Role of remote sensing in documenting living resources
N78-21554
Coastal upwelling ecosystems analysis. Technical report 34: Physical and biological measurements, 29 July - 5 August 1973
[PB-276486/8] N78-21746
Aerospace Medicine and Biology: A continuing bibliography with indexes, supplement 178
[NASA-SP-7011(178)] N78-21750
MARINE METEOROLOGY
Mariners weather log, volume 21, number 6, November 1977
[PB-276467/8] N78-21734
MARKET RESEARCH
Systems integration of marketable subsystems: A collection of progress reports
[NASA-CR-150587] N78-21594
MARKOV PROCESSES
Optimal control of a storage system
N78-21772
Stationary stochastic and discrete Markov process. Part 1: The range of a strictly stationary stochastic process. Part 2: Some additional results concerning limits of a discrete Markov process
N78-21868
MARS SURFACE SAMPLES
Technology for return of planetary samples, 1977
[NASA-CR-156169] N78-21181
MARYLAND
Maryland Automated Geographic Information System
N78-21534
Thermal discharges and their role in pending power plant regulatory decisions
N78-21547
Work on power-plant [air] plumes involving remote sensing of SO2
N78-21548
Water quality and shellfish sanitation --- Patuxent and Choptank River watersheds
N78-21550
Application of a computerized environmental information system to master and sector planning
N78-21561
MASS FLOW
A brief examination of the flow external to an F-111 intake at Mach 1.6
[ARL/ME-NOTE-357] N78-21054
MASS SPECTROMETERS
A small gas inlet system for orbital mass-spectrometer calibrations
[NASA-TP-1170] N78-21430
A feasibility study of ion implantation techniques for mass spectrometer calibration
[NASA-TP-1185] N78-21431

MASS TRANSFER
Mass transport and electrical conductivity in oxides containing a submicron dispersion of a second oxide phase
N78-21259
Two theoretical problems in close binary stars
N78-21995

MATCHED FILTERS
Monolithic surface wave transversal filter
[AD-A049938] N78-21385

MATHEMATICAL MODELS
Nitric oxide formation in gas turbine engines: A theoretical and experimental study
[NASA-CR-2977] N78-21116
A comparison between predicted and measured species concentrations and velocities in a research combustor
N78-21158
Summer faculty systems design program. Integrating wind tunnels and computers. Volume 2: Details of summer design study USAF/OSR/ASEE
[AD-A050071] N78-21167
Summer faculty systems design program. Integrating wind tunnels and computers. Volume 1: Executive summary. USAF/OSR/ASEE
[AD-A050072] N78-21171
Simplified model of statistically stationary spacecraft rotation and associated induced gravity environments
[NASA-TM-78164] N78-21198
Mathematical simulation of power conditioning systems. Volume 1: Simulation of elementary units. Report on simulation methodology
[NASA-TM-75209] N78-21212
Modeling of convective mode combustion through granulated propellant to predict transition to detonation
[AD-A049499] N78-21302
Evaluation of two computer programs for modeling electromagnetic interactions with surfaces
[UCRL-52321] N78-21368
Numerical calculation of the stability of parallel flows
[AD-A049983] N78-21418
Fundamental mechanisms of nonequilibrium MHD lasing phenomena
[AD-A049509] N78-21447
Design of interactive manufacturing and quality systems subject to inspection error using dynamic programming
N78-21481
The effect of modeling depth on reliability prediction for systems subject to a phased mission profile
[AD-A050246] N78-21482
On the stochastic modeling of daily streamflows
N78-21508
Integrating wave power into the electricity supply system
[RR-20] N78-21609
Filtration model for coal fly ash with glass fabrics
[PB-276489/2] N78-21667
Review of diesel combustion models for NOx and smoke emissions
[PB-276350/6] N78-21681
Physical mechanisms of extra area effects from weather modification
N78-21715
The development of a mesoscale semi-implicit numerical model
N78-21716
Methods for estimating areal precipitation in mountainous areas
[PB-276140/1] N78-21731
Estimation and hypothesis testing for generalized multivariate analysis of covariance models
N78-21832
Statistical analysis of a forecasting model using one-dimensional nonlinear transformations
N78-21843
Experimental and theoretical studies of ion-molecule scattering
N78-21898
Some highlights of theoretical and computational plasma physics, part 2
[UCRL-79600-PT-2] N78-21936
Critical phenomena of inhomogeneous ising models
N78-21939
Quasiclassical methods in the linear Heisenberg model
N78-21940
Simulation model for resource policy evaluation
[PB-275938/9] N78-21990

MATHEMATICAL PROGRAMMING
At the interface of modeling and algorithms research
[AD-A049757] N78-21806

MATRICES (CIRCUITS)
Thin-film bucket brigade device charge-transfer efficiency improvements for display applications
[AD-A050475] N78-21387

MATRICES (MATHEMATICS)
Numerical results or multiconductor transmission line networks
[AD-A049451] N78-21349
Reduction of a large polynomial matrix to Smith-normal-form by unimodular block-partitioning transformation
[AD-A049453] N78-21845
Matrix inversion using the RADC STARAN associative array processor
[AD-A049617] N78-21849
A Liapunov functional for a matrix neutral difference-differential equation with one display
[AD-A049868] N78-21859

MATRIX THEORY
An alternative method for a global analysis of quadratic programs in a finite number of steps
[AD-A049756] N78-21805
Reduction of a large polynomial matrix to Smith-normal-form by unimodular block-partitioning transformation
[AD-A049453] N78-21845

MATTER (PHYSICS)
Considerations on dense matter in astrophysics
N78-22002

MAXIMUM LIKELIHOOD ESTIMATES
The numerical evaluation of maximum-likelihood estimates of the parameters for a mixture of normal distributions from partially identified samples
[NASA-CR-151699] N78-21842
Estimation of the operating characteristics of item response categories. 1: Introduction to the two-parameter beta method
[AD-A049618] N78-21873

MEASURING INSTRUMENTS
Measuring techniques in high temperature turbines
N78-21151
A fully automated system for pulsed NMR measurements
N78-21228
Wave measurement and implementation aboard ship
[PB-276070/0] N78-21741

MECHANICAL IMPEDANCE
Pulse applications and parameter identification for US Navy medium-weight shock machine
[AD-A050120] N78-21500

MECHANICAL PROPERTIES
Titanium/beryllium laminates: Fabrication, mechanical properties, and potential aerospace applications
[NASA-TM-73891] N78-21221
Influence of metal variables on the structure and properties of heavy section ductile iron
N78-21253
The influence of retained austenite on the thick section mechanical properties of a commercial low alloy ultra-high strength steel
N78-21254
A study of the effect of carbon upon the elevated temperature mechanical, fracture and static load crack extension behavior of austenitic stainless steel
N78-21255
An investigation of the influence of shock-wave profile on the mechanical and thermal responses of polycrystalline iron
[AD-A049764] N78-21278
Definition of tire properties required for landing system analysis
[NASA-CR-156171] N78-21326

MECHANICAL SHOCK
Pulse applications and parameter identification for US Navy medium-weight shock machine
[AD-A050120] N78-21500
On the dissipation associated with equilibrium shocks in finite elasticity
[AD-A050031] N78-21501

MEDICAL SCIENCE
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 24
[JPRS-70928] N78-21761

MERCURY (METAL)
Evolution of the 1-mlb mercury ion thruster subsystem
[NASA-TM-73733] N78-21202
Planned flight test of a mercury ion auxiliary propulsion system. 1: Objectives, systems descriptions, and mission operations
[NASA-TM-78859] N78-21204
Effect of facility background gases on internal erosion of the 30-cm Hg ion thruster
[NASA-TM-73803] N78-21205
Diagnostic evaluations of a beam-shielded 8-cm mercury ion thruster
[NASA-TM-78855] N78-21207
Constrained sloshing of liquid mercury in a flexible spherical tank
[NASA-TM-78833] N78-21403

MERCURY COMPOUNDS
Application and theoretical studies of silver and mercuric sulfide-based ion selective electrodes
N78-21369

MERCURY ION ENGINES
Pulse ignition characterization of mercury ion thruster hollow cathode using an improved pulse ignitor
[NASA-TM-78858] N78-21203
Effect of facility background gases on internal erosion of the 30-cm Hg ion thruster
[NASA-TM-73803] N78-21205
A review of electron bombardment thruster systems/spacecraft field and particle interfaces
[NASA-TM-78850] N78-21206
Diagnostic evaluations of a beam-shielded 8-cm mercury ion thruster
[NASA-TM-78855] N78-21207
The 5200 cycle test of an 8-cm diameter Hg ion thruster
[NASA-TM-78860] N78-21208
Planned flight test of a mercury ion auxiliary propulsion system. Part 2: Integration with host spacecraft
[NASA-TM-78869] N78-21209

METABOLIC WASTES
Fuel gas production from animal waste, phase 1
[COO-2991-17] N78-21321

METABOLISM
Working in a hot environment; perspiration loss; a drink for persons working under hot conditions, part 2
[NASA-TM-75285] N78-21751

METAL FILMS
Investigation of the surface roughness of evaporated copper films by optical scattering
N78-21252

METAL IONS
Evolution of the 1-mlb mercury ion thruster subsystem
[NASA-TM-73733] N78-21202
Planned flight test of a mercury ion auxiliary propulsion system. 1: Objectives, systems descriptions, and mission operations
[NASA-TM-78859] N78-21204

METAL JOINTS
Studies on the failure of metal mechanical joints subjected to dynamic loads
[AD-A050076] N78-21503

METAL OXIDES
Thermochemical and kinetic data of gaseous metal oxides and their relationship to atmospheric composition
[AD-A050162] N78-21700

METAL PLATES
Finite viscoplastic deflections of an impulsively loaded plate by the mode approximation technique
[AD-A049827] N78-21499
Experiments on viscoplastic response of circular plates to impulsive loading
[AD-A049866] N78-21502

METAL POWDER
The effect of varying quench rates and heating rates on the aging response of an aluminum powder alloy
[AD-A0497444] N78-21272

METAL SHEETS
Code of practice for the cupping test for sheet and strip metal [modified Erichsen test]
[SABS-0138-1977] N78-21263
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 1: Program summary and data analysis
[NASA-CR-135369] N78-21493
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 2: Crack opening displacement and stress-strain data
[NASA-CR-135370] N78-21494

METAL STRIPS
Code of practice for the cupping test for sheet and strip metal [modified Erichsen test]
[SABS-0138-1977] N78-21263

METAL VAPORS
Optical quadrupole sum frequency generation in metal vapor
N78-21907

METAL WORKING
Influence of metal variables on the structure and properties of heavy section ductile iron
N78-21253

METAL-METAL BONDING
Fabrication of stainless steel clad tubing — gas pressure bonding
[NASA-CP-135347] N78-21265

METALS
Photochemical and kinetic studies of some metal dithizonate complexes
[AD-A049872] N78-21243
Tables of Brinell and Vickers hardness values for metallic materials with flat surfaces, and of correction factors [Vickers] for curved surfaces
[SABS-055A-1977] N78-21262
Code of practice for methods for hardness testing of metallic materials
[SABS-055-1977-REV-1] N78-21264
Method of plastic deformation of metals and alloys
[AD-A049391] N78-21280
Effluent monitoring procedures: Metals analyses. Student reference manual
[PB-275391/1] N78-21674
Effluent monitoring procedures: Metals analyses. Staff guide for conducting the course
[PB-275393/7] N78-21675

METEORITIC COMPOSITION
Laboratory simulation of infrared astrophysical features — silicate mixtures with emission spectra matching those of comets
N78-21998

METEOROLOGICAL INSTRUMENTS
AFAL tower characterization facility: 4 km weather instrumentation tower
[AD-A049525] N78-21067
A small aircraft gust-probe system
[PB-276429/8] N78-21106
METEOROLOGICAL PARAMETERS
Energy conservation via solar energy application to multi-family and commercial structures. Volume 2, part 2: Solar energy atlas for New York state
[PB-276130/2] N78-21618
METEOROLOGICAL SATELLITES
Characteristic size spectra of cumulus fields observed from satellites
[AD-A049936] N78-21724
A report on the Chesapeake Bay region NOWCASTING experiment
[PB-277102/0] N78-21732
METEOROLOGICAL SERVICES
The 14823A Lance missile no. 3293, round no. 300 AST 5 October 1977
[AD-A049430] N78-21728
METEOROLOGY
Summarization and interpretation of historical physical oceanographic and meteorological information for the Mid-Atlantic region
[PB-277104/6] N78-21506
A numerical investigation of the boundary layer of an atmospheric mesoscale vortex
N78-21688
The 12829C Lance missile no. 4236, round no. 299 RSL, 25 August 1977
[AD-A049435] N78-21726
The 14821A Lance missile no. 3294, round no. 301 APL, 5 October 1977
[AD-A049431] N78-21727
Mariners weather log, volume 21, number 6, November 1977
[PB-276467/8] N78-21734
The quality of NOAA's ocean research and development program: An evaluation
[PB-277095/6] N78-21980
METHANE
Investigation of converting the product of coal gasification to methane by the action of microorganisms, phase I
[FE-2203-16] N78-21319
METHODOLOGY
Standard techniques for presentation and analysis of crater size-frequency data
[NASA-TM-79730] N78-22006
METRIC SPACE
Contributions to the dimensional theory
N78-21835
MEXICO
Use of satellite images in the evaluation of farmlands — in Mexico
[NASA-TM-75088] N78-21575
MICROBIOLOGY
Aerospace Medicine and Biology: A continuing bibliography with indexes, supplement 178
[NASA-SP-7011[178]] N78-21750
MICROELECTRONICS
Proceedings of the 1st Annual Rocky Mountain Symposium on Microcomputers: Systems, Software, Architecture
[AD-A049559] N78-21786
MICROORGANISMS
Investigation of converting the product of coal gasification to methane by the action of microorganisms, phase I
[FE-2203-16] N78-21319
MICROPHONES
Miniature stereomicrophone
[NHK-LABS-NOTE-213] N78-21331
MICROPROCESSORS
Microprocessor-based cardiopulmonary monitoring system
[NASA-CR-151688] N78-21752
Scientific calculating system with a number-oriented microprocessor sequenced by a single component microcomputer
[LA-UR-2383] N78-21789
MICROSTRUCTURE
Microstructure evolution during sintering of beta - alumina compositions
N78-21258
MICROWAVE AMPLIFIERS
Calculation of optimum operating parameters for a gyrotron traveling wave amplifier
[AD-A049506] N78-21375
MICROWAVE EMISSION
Microwave emission from polar firn
[NASA-TP-1212] N78-21690
MICROWAVE EQUIPMENT
Cryogenically-cooled microwave acoustic relay devices
[AD-A049765] N78-21382
Estimation of marine environmental parameters using microwave radiometric remote sensing systems
[AD-A049507] N78-21738
MICROWAVE FREQUENCIES
Generation and detection of microwave phonons in N-type indium antimonide
N78-21945
MICROWAVE IMAGERY
Active Microwave Users Workshop Report
[NASA-CP-2030] N78-21562
Summary of the active microwave users workshop
N78-21563
Applications of active microwave imagery
N78-21564
Seasat land experiments
N78-21565
Active microwave users working group program planning
N78-21566
Synthetic Aperture Radar [SAR] data processing
N78-21567
MICROWAVE LANDING SYSTEMS
Accuracy considerations on new Microwave Landing Systems [MLS] from an operational point of view
N78-21081
A hybrid guidance system for all-weather approach and landing
N78-21088
MICROWAVE RADIOMETERS
Snow parameters from Nimbus-6 electrically scanned microwave radiometer — [ESMR-6]
[NASA-CR-156725] N78-21572
Severe storms observing satellite [STORMSAT]
[NASA-CR-156735] N78-21720
Estimation of marine environmental parameters using microwave radiometric remote sensing systems
[AD-A049507] N78-21738
MICROWAVE SENSORS
Summary of the active microwave users workshop
N78-21563
MICROWAVE TRANSMISSION
Space solar power. Description of concept, results of preliminary studies, requirements for evaluation
[NASA-TM-79436] N78-21611
Solar power satellites
[NASA-TM-79434] N78-21612
MICROWAVE TUBES
Klystron-twt hybrid efficiency improvement
[AD-A050125] N78-21377
MIDDLE EAR
Transmission of impulse noise to the inner ear in the guinea pig by the recording of the intracochlear pressure. Evaluation of phenomena leading to injuries
[ISL-R-103/77] N78-21749
MILITARY AIR FACILITIES
Area navigation systems and procedures
N78-21091
MILITARY AIRCRAFT
Navigation, guidance and control for high performance military aircraft
N78-21090
MILITARY OPERATIONS
Cost-effectiveness of flight simulators for military training. Volume 2: Estimating costs of training in simulators and aircraft
[AD-A049979] N78-21168
MILLIMETER WAVES
A depolarization and attenuation experiment using the COMSTAR and CTS satellites
[NASA-CR-156730] N78-21336
MINERAL DEPOSITS
Evaluation of LANDSAT MSS vs TM simulated data for distinguishing hydrothermal alteration
[NASA-CR-156168] N78-21569
MINERAL OILS
Characterization of wear debris generated in accelerated rolling-element fatigue tests
[NASA-TP-1203] N78-21470
MINIATURE ELECTRONIC EQUIPMENT
Miniature stereomicrophone
[NHK-LABS-NOTE-213] N78-21331
MINICOMPUTERS
Proceedings of the 1st Annual Rocky Mountain Symposium on Microcomputers: Systems, Software, Architecture
[AD-A049559] N78-21786
PDP 11 image processing software
[AD-A049586] N78-21799
An assembly-language minicomputer software development system
[PB-276108/8] N78-21815
MINIMAX TECHNIQUE
A note on the use of local MIN and MAX operations in digital picture processing
[AD-A049589] N78-21802
MIRRORS
Preliminary design analysis for the solar optical telescope main mirror actuator
[NASA-CR-156701] N78-21999
MISALIGNMENT
Orbit prediction errors resulting from vertical misalignment of a radar antenna
[AD-A050161] N78-21186
MISSILE RANGES
USMR [White Sands Missile Range] atmospheric structure constant [C sub n, sup 2] survey
[PB-276097/3] N78-21711
MISSION PLANNING
Payload planning information development study
[NASA-CR-150633] N78-21175
Planned flight test of a mercury ion auxiliary propulsion system. 1: Objectives, systems descriptions, and mission operations
[NASA-TM-78859] N78-21204
HCMM satellite to take earth's temperature
[NASA-NEWS-RELEASE-78-60] N78-21507
MIXING
Shear dispersion in time-varying flows
[PB-277103/8] N78-21421
MIXING CIRCUITS
Performance limits of a Josephson junction mixer
[AD-A049544] N78-21963
MODELS
Fundamental and semi-global kinetic mechanisms of hydrocarbon combustion
[COO/4272-1] N78-21245
Mosaic models for image analysis and synthesis
[AD-A050100] N78-21826
MODES [STANDING WAVES]
Diffusion process for formation of single-mode waveguide
[AD-A049558] N78-21915
MODULATION
A study of the field modulated generator system
N78-21371
MODULUS OF ELASTICITY
Pressure dependence of the elastic moduli of body-centered-cubic transition metals
N78-21943
MOLECULAR COLLISIONS
Experimental and theoretical studies of ion-molecule scattering
N78-21898
Semiclassical methods for nonseparable systems
[LBL-6662] N78-21903
MOLECULAR SPECTRA
A survey of carbon monoxide in Cygnus X
N78-21997
MOLECULAR SPECTROSCOPY
Broadness of optical impurity spectra in the solid state
N78-21899
Study of diatomic molecules. 2: Intensities — optical emission spectroscopy of ScO
[NASA-TM-75290] N78-21900
MOLECULAR TRAJECTORIES
Calculated rate constants for the reaction ClO + O yields Cl + O2 between 220 and 1000 deg K — molecular trajectories and stratospheric ozone
[NASA-TM-78483] N78-21215
MOLLUSKS
Water quality and shellfish sanitation — Patuxent and Choptank River watersheds
N78-21550
MOLYBDENUM COMPOUNDS
The superconductivity of certain ternary molybdenum compounds
[NASA-TM-75250] N78-21958
MONITORS
Loose-parts monitoring: Present status of the technology, its implementation in US reactors, and some recommendations for achieving improved performance
[CONF-770902-5] N78-21483
Survey and comparison of solar activity and energetic particle emission in 1970
[AD-A048479] N78-22013
MONOCHROMATORS
Analytical capabilities of a dc plasma-echelle spectrometer system
N78-21230
MONTE CARLO METHOD
Integrating wave power into the electricity supply system
[RR-20] N78-21609
Further progress on robust/resistant widthers
[AD-A049701] N78-21852
MOSAICS
Mosaic models for image analysis and synthesis
[AD-A050100] N78-21826
MOTIVATION
Motivation and intensionality in a computer simulation model
N78-21790
MUD
Earthflow
N78-21684
MULTICHANNEL COMMUNICATION
Studies for the development of a unified node employing dynamic channel location
[AD-A049619] N78-21356
MULTILAYER INSULATION
Comparison of reusable insulation systems for cryogenically-tanked earth-based space vehicles
[NASA-TM-73668] N78-21190
MULTIMISSION MODULAR SPACECRAFT
Severe storms observing satellite [STORMSAT]
[NASA-CR-156735] N78-21720
MULTIPLIERS
A gradient projection-multiplier method for nonlinear programming
[AD-A049864] N78-21811

MULTISPECTRAL BAND SCANNERS
The Chesapeake Bay: A challenge to the remote sensing community
N78-21535
Evaluation of LANDSAT MSS vs TM simulated data for distinguishing hydrothermal alteration
[NASA-CR-156168] N78-21569
MULTIVARIATE STATISTICAL ANALYSIS
Estimation and hypothesis testing for generalized multivariate analysis of covariance models
N78-21832

N

N-TYPE SEMICONDUCTORS
Generation and detection of microwave phonons in N-type indium antimonide
N78-21945
NACELLES
Theoretical flow characteristics of inlets for tilting-nacelle VTOL aircraft
[NASA-TP-1205] N78-21114
NASA PROGRAMS
Synthetic Aperture Radar [SAR] data processing
N78-21567
Continued implementation and testing of a Neighborhood Office Center [NOC] and integration of the NOC with an administrative correspondence management information system
[NASA-CR-156150] N78-21970
NATIONAL AVIATION SYSTEM
Alternative future scenarios for the national system. Volume 1: Executive summary — overview of study methods and results
[AD-A047084] N78-21065
NATURAL GAS
Emergency natural gas purchases: Actions needed to correct program abuses and consumer inequities
[PB-275876/1] N78-21313
Evaluation of the use of hydrogen as a supplement to natural gas
[TID-27747] N78-21323
NAVIER-STOKES EQUATION
The development of a mesoscale semi-implicit numerical model
N78-21716
NAVIGATION
Navigation, guidance and control for high performance military aircraft
N78-21090
Area navigation systems and procedures
N78-21091
NAVIGATION AIDS
Future applications of low cost strapdown laser inertial navigation systems
N78-21072
New techniques for low cost strapdown inertial systems
N78-21073
Recent advances in high resolution inertial navigation
N78-21075
Precise enroute navigation based on ground-derived techniques
N78-21078
The Joint Tactical Information Distribution System [JTIDS]
N78-21086
Development of the integrated all-weather navigation system for tornado [MRCA]
N78-21089
NAVY
Satellite surveillance avoidance optimization aid — for naval operations
[AD-A049561] N78-21195
NEODYMIUM LASERS
Laser-fusion studies at NRL: A report to ERDA
[AD-A050089] N78-21451
NETWORK ANALYSIS
FLOWNET: A computer program for calculating secondary flow conditions in a network of turbomachinery
[NASA-TM-73774] N78-21791
A new approach to computer aided transient analysis of stiff linear networks
N78-21818
NETWORK SYNTHESIS
A synthesis technique for the resolution of large scale fluid logic networks
N78-21400
Continued implementation and testing of a Neighborhood Office Center [NOC] and integration of the NOC with an administrative correspondence management information system
[NASA-CR-156150] N78-21970
NETWORKS
Use of Floyd's algorithm to find shortest restricted paths
[AD-A049467] N78-21797
NEUTRAL PARTICLES
Induced oscillation instabilities and their role in Tokamaks with injected neutral particles
[ERDA-TR-312] N78-21932
NEUTRON ACTIVATION ANALYSIS
Activation analysis of admixtures in certain semiconductive materials
[NASA-TM-75258] N78-21231
NEW JERSEY
Trenton ICES, volume 1, phase 1
[COO/4212-1/1-VOL-1] N78-21639
NEW YORK
Remote sensing of water quality
N78-21541
Energy conservation via solar energy application to multi-family and commercial structures. Volume 2, part 2: Solar energy atlas for New York state
[PB-276130/2] N78-21618
Coastal wetlands along Lake Ontario and the St. Lawrence in Jefferson County, New York
[PB-276031/2] N78-21744
NICKEL ALLOYS
High temperature corrosion of Ni-base for turbine blades alloys in sulphate-chloride containing environments
N78-21140
Theory of amorphous CuNi alloys
N78-21250
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and in 100
[NASA-TM-78828] N78-21267
NICKEL CADMIUM BATTERIES
SMS/GOES cell and battery data analysis report
[NASA-CR-156739] N78-21606
NICKEL COMPOUNDS
Variation of interdiffusion coefficient and ratio of intrinsic diffusion coefficients with composition in the NiAl [delta] phase of the Al-Ni system
N78-21257
NIMBUS 4 SATELLITE
User's guide to the Nimbus-4 backscatter ultraviolet experiment data sets
[NASA-TM-78069] N78-21694
NIMBUS 5 SATELLITE
Analysis of global oceanic rainfall from microwave data
[NASA-CR-156737] N78-21719
NIMBUS 6 SATELLITE
Snow parameters from Nimbus-6 electrically scanned microwave radiometer — [ESMR-6]
[NASA-CR-156725] N78-21572
NIOBIUM
Metastable metallic superconductors with high transition temperatures and composite superconductors
[AD-A050055] N78-21282
The Fermi surface of niobium
N78-21942
NIOBIUM COMPOUNDS
Properties of new superconducting materials — niobium and germanium compounds
[AD-A050296] N78-21959
NITRIC OXIDE
Nitric oxide formation in gas turbine engines: A theoretical and experimental study
[NASA-CR-2977] N78-21116
NITRIDES
Development of SiAlON materials
[NASA-CR-135290] N78-21289
NITROAMINES
Complex formation in RDX, HMX, TNT, and some related compounds: A bibliography
[AD-A050090] N78-21306
NITROGEN
Design, fabrication, and testing of a full-scale breadboard in nitrogen generator for fuel tank inerting application
[AD-A049459] N78-21097
Vacuum ultraviolet and visible radiation from electron impact excitation of nitrogen, hydrogen, oxygen, the light hydrocarbons and the rare gases
N78-21897
Ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas
[NASA-CR-156068] N78-21924
NITROGEN OXIDES
Technical assessment of NOx removal processes for utility application
[PB-276637/6] N78-21670
Preliminary environmental assessment of combustion modification techniques. Volume 1: Summary
[PB-276680/6] N78-21677
Preliminary environmental assessment of combustion modification techniques. Volume 2: Technical results
[PB-276681/4] N78-21678
Review of diesel combustion models for NOx and smoke emissions
[PB-276350/6] N78-21681
The fate of nitrogen oxides in the atmosphere: Summary of an exploratory study in Phoenix, Arizona
[PB-276355/5] N78-21707
NOAA SATELLITES
The quality of NOAA's ocean research and development program: An evaluation
[PB-277095/6] N78-21980
NOISE INJURIES
Transmission of impulse noise to the inner ear in the guinea pig by the recording of the intracochlear pressure. Evaluation of phenomena leading to injuries
[ISL-R-103/77] N78-21749
NOISE INTENSITY
Approximations for the amplitude distribution and density of shot processes
N78-21370
NOISE MEASUREMENT
Comparison of the noise characteristics of two low pressure ratio fans with a high throat Mach number inlet
[NASA-TM-73880] N78-21108
NOISE POLLUTION
Evaluation of noise nuisance: A study of willingness to receive payment for noise introduced into the home
[PB-276418/1] N78-21658
NOISE REDUCTION
Use of leaning vanes in a two stage fan
[NASA-CR-152134] N78-21115
Experimental and theoretical sound transmission — reduction of interior noise in aircraft
[NASA-CR-156170] N78-21889
Airport and aircraft noise reduction
[GPO-91-591] N78-21891
NOISE SPECTRA
Speckle noise in satellite based lidar systems
[NASA-CR-156723] N78-21444
NOMOGRAPHS
Operational decision aids: The application of nomography and uncertainty analysis to decision-aiding systems
[AD-A049545] N78-21974
NONDESTRUCTIVE TESTS
Nondestructive evaluation of metal fatigue
[AD-A049539] N78-21277
Evaluation of flaw indications by ultrasonic pulse amplitude and phase spectroscopy
[ORNL-TR-4355] N78-21484
Determination of boron and lithium by recording the products from [n, alpha] reactions
[NASA-TM-75260] N78-21904
NONLINEAR EQUATIONS
Role of statistical linearization in the solution of nonlinear stochastic equations
[UCRL-80094] N78-21867
NONLINEAR OPTICS
Nonlinear optical effects in liquid crystals
N78-21937
NONLINEAR PROGRAMMING
A gradient projection-multiplier method for nonlinear programming
[AD-A049864] N78-21811
NONLINEAR SYSTEMS
A perturbation method for predicting amplitudes of nonlinear wheel shimmy
N78-21464
NONLINEARITY
Statistical analysis of a forecasting model using one-dimensional nonlinear transformations
N78-21843
NONPARAMETRIC STATISTICS
A method for assessment of the natural variability found in hurricanes through use of ranking techniques and nonparametric statistics
[PB-276430/6] N78-21733
NONUNIFORM FLOW
Airfoil profile in a nonuniform flow
[NASA-TM-75272] N78-21048
NONUNIFORM PLASMAS
Induced oscillation instabilities and their role in Tokamaks with injected neutral particles
[ERDA-TR-312] N78-21932
NORMAL DENSITY FUNCTIONS
The numerical evaluation of maximum-likelihood estimates of the parameters for a mixture of normal distributions from partially identified samples
[NASA-CR-151699] N78-21842
NOZZLE FLOW
Wind tunnel performance tests of coannular plug nozzles — in the Langley 8 x 6 ft. supersonic wind tunnel
[NASA-CR-2990] N78-21044
NUCLEAR FUELS
Four Workshops in Alternate Concepts in Controlled Fusion. Part A: Executive summaries. Part B: Extended summaries. Part C: CTR using the p-B-11 reaction
[EPRI-ER-429-SR-PT-A] N78-21927
NUCLEAR FUSION
High thermal efficiency, radiation-based advanced fusion reactors
[EPRI-ER-544] N78-21926
NUCLEAR MAGNETIC RESONANCE
A fully automated system for pulsed NMR measurements
N78-21228
Studies of transition metal analogs of hexaborane [10]. Nuclear magnetic resonance studies of heptaborane species
N78-21249

NUCLEAR RADIATION SPECTROSCOPY
Determination of boron and lithium by recording the products from [n, alpha] reactions
[NASA-TM-75260] N78-21904

NUCLEAR REACTORS
Loose-parts monitoring: Present status of the technology, its implementation in US reactors, and some recommendations for achieving improved performance
[CONF-770902-5] N78-21483

NUCLEI [NUCLEAR PHYSICS]
The evaluation and energy propagation of relativistic electron-nucleus Bremsstrahlung and virtual photon spectra
N78-21895

NUMERICAL ANALYSIS
Numerical investigation of the effect of a Coriolis force on the stability of plane Poiseuille flow
[AD-A049521] N78-21414
Analytical and numerical investigation of structural response of compliant wall materials
[NASA-CR-156151] N78-21491
The numerical evaluation of maximum-likelihood estimates of the parameters for a mixture of normal distributions from partially identified samples
[NASA-CR-151699] N78-21842
Direct numerical solution of large sets of simultaneous equations
[AD-A050058] N78-21850
Application and numerical solution of Abel-type integral equations
[AD-A049396] N78-21861

NUTRITIONAL REQUIREMENTS
Working in a hot environment; perspiration loss; a drink for persons working under hot conditions, part 2
[NASA-TM-75285] N78-21751

O

OCCULTATION
On the theory and analysis of occultation light curves
N78-22005

OCEAN BOTTOM
Conductivity of the ocean crust
N78-21686

OCEAN DATA ACQUISITIONS SYSTEMS
Summarization and interpretation of historical physical oceanographic and meteorological information for the Mid-Atlantic region
[PB-277104/6] N78-21506

OCEAN MODELS
Hydraulic model of the Chesapeake Bay
N78-21539
Theoretical study to determine the sea state limit for the survival of oil slicks on the ocean
[AD-A049794] N78-21666
Dynamical numerical prediction of large-scale thermal anomalies in the North Pacific Ocean
[AD-A049919] N78-21740

OCEAN SURFACE
Measurement of near sea surface turbulence and possible wave influence
[AD-A049951] N78-21704
Temperature fine-structure in the Southern Ocean
N78-21735

OCEAN THERMAL ENERGY CONVERSION
Net energy analysis of an Ocean Thermal Energy Conversion [OTEC] system
[ORAU/IEA[M]-77-1] N78-21652

OCEANOGRAPHIC PARAMETERS
Coastal upwelling ecosystems analysis, data report 39. Joint 2: R/V Thomas G. Thompson cruise 108 leg 1, CTD measurements off the coast of Peru near Cabo Nazca, April - May 1976
[PB-276532/9] N78-21742
Coastal upwelling ecosystems analysis, data report 40. Joint 2: R/V Thomas G. Thompson cruise 108 legs 2 and 3, CTD measurements off the coast of Peru near Cabo Nazca, May - June 1976
[PB-276533/7] N78-21743
Coastal upwelling ecosystems analysis. Data report 41: Physical, chemical and biological observations from JOINT 2 R/V ALPHA HELIX, Leg O, 5-20 March 1976
[PB-276297/9] N78-21745

OCEANOGRAPHY
Summarization and interpretation of historical physical oceanographic and meteorological information for the Mid-Atlantic region
[PB-277104/6] N78-21506
Estimation of marine environmental parameters using microwave radiometric remote sensing systems
[AD-A049507] N78-21738
The quality of NOAA's ocean research and development program: An evaluation
[PB-277095/6] N78-21980

OCEANS
Response of the upper ocean to Hurricane Eloise
[AD-A050245] N78-21722

OIL EXPLORATION
Use of the method of one-dimensional nonlinear transformations to forecast the natural model of an oil stratum
N78-21693

OIL POLLUTION
Summarization and interpretation of historical physical oceanographic and meteorological information for the Mid-Atlantic region
[PB-277104/6] N78-21506

OIL SLICKS
Chemical and physical properties of refined petroleum products
[PB-277100/4] N78-21312
Theoretical study to determine the sea state limit for the survival of oil slicks on the ocean
[AD-A049794] N78-21666

ONBOARD EQUIPMENT
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10105] N78-21511

OPERATIONS RESEARCH
The effect of modeling depth on reliability prediction for systems subject to a phased mission profile
[AD-A050246] N78-21482
Mathematics of operations research
[AD-A049700] N78-21853

OPERATOR PERFORMANCE
Code of practice for welding. Part 5: Welders' competence tests for manual oxy-acetylene, manual metal-arc, manual gas-shielded tungsten-arc, and manual gas-shielded metal-arc welding of mild steel [carbon steel] and medium high tensile steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-5-1976-REV-1] N78-21467

OPERATORS [MATHEMATICS]
On Nth roots of positive operators
[NASA-CR-151697] N78-21841

OPTICAL DATA PROCESSING
Associative array processing of raster scanned data for automated cartography II: Improved resolution and data handling
[AD-A049698] N78-21379
Use of satellite images in the evaluation of farmlands --- in Mexico
[NASA-TM-75088] N78-21575

OPTICAL EMISSION SPECTROSCOPY
Analytical capabilities of a dc plasma-echelle spectrometer system
N78-21230
Broadness of optical impurity spectra in the solid state
N78-21899
Study of diatomic molecules. 2: Intensities --- optical emission spectroscopy of ScO
[NASA-TM-75290] N78-21900

OPTICAL PROPERTIES
Nonlinear optical effects in liquid crystals
N78-21937
Theoretical studies of optical phenomena in solids
N78-21946

OPTICAL PUMPING
Optically pumped mercury laser for absolute frequency stabilization
N78-21440
Optical conversion processes
[AD-A049583] N78-21448
Optically pumped mercury lasers for ring laser gyroscope applications
[AD-A049540] N78-21455

OPTICAL RADAR
Speckle noise in satellite based lidar systems
[NASA-CR-156723] N78-21444
Engineering study for pallet adapting the Apollo laser altimeter and photographic camera system for the Lidar Test Experiment on orbital flight tests 2 and 4
[NASA-CR-152615] N78-21525
Lidar: A laser technique for remote sensing
N78-21549

OPTICAL REFLECTION
Electroreflectance in semiconductors and its application as a method of materials characterization
N78-21950

OPTICAL TRANSFER FUNCTION
An incoherent optical implementation of the two-dimensional Walsh transform
N78-21911

OPTICAL WAVEGUIDES
Parabolic profiling by the molecular stuffing process
N78-21908

OPTICS
Optical quadrupole sum frequency generation in metal vapor
N78-21907

OPTIMAL CONTROL
Optimal control of a storage system
N78-21772
Optimal dispatching of a finite capacity shuttle
[AD-A049595] N78-21824
The Landau problem for motions on curves
[AD-A049492] N78-21828

OPTIMIZATION
System optimization by periodic control
[AD-A049522] N78-21162
MINKIT: An optimization system
[ANL-AMD-TM-305] N78-21817
Approximate solutions for certain optimal stopping problems
[AD-A049995] N78-21856

ORGANIC WASTES [FUEL CONVERSION]
Fuel gas production from animal waste, phase 1
[COO-2991-17] N78-21321

ORGANIZATIONS
AGARD highlights --- flight mechanics activities
[AGARD-HIGHLIGHTS-78/1] N78-21046
The quality of NOAA's ocean research and development program: An evaluation
[PB-277095/6] N78-21980
National Science Foundation --- research projects and technology assessment
[NSF-77-1] N78-22018

OROGRAPHY
Orographic precipitation model for hydrometeorological use
N78-21714

ORTHOTROPISM
Simple torsion test for shear moduli determination of orthotropic composites
[NASA-TM-78485] N78-21490

OSCILLATORS
Surface acoustic wave stabilized oscillators
[NASA-CR-156724] N78-21374

OXIDATION-REDUCTION REACTIONS
Oxidation kinetics of hydrocarbon fuels
[AD-A050056] N78-21311

OXIDIZERS
Inorganic halogenoxidizer research
[AD-A050133] N78-21238
International Conference on Oxidants, 1976: Analysis of Evidence and Viewpoints. Part 1: Definition of key issues
[PB-276768/9] N78-21679

OXYGEN
Temperature profile of graphite surface burning in a stream of oxygen
[NASA-TM-75271] N78-21232
Development of SiAlON materials
[NASA-CR-135290] N78-21289
Ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas
[NASA-CR-156068] N78-21924

OZONE
Calculated rate constants for the reaction ClO + O yields Cl + O2 between 220 and 1000 deg K --- molecular trajectories and stratospheric ozone
[NASA-TM-78483] N78-21215
The relation of oxidant levels to precursor emissions and meteorological features. Volume 2: Review of available research results and monitoring data, as of November 1975
[PB-275326/7] N78-21672
The relation of oxidant levels to precursor emissions and meteorological features. Volume 3: Appendices [analytical methods and supplementary data]
[PB-275327/5] N78-21673
Software development: Stratosphere modeling
[NASA-CR-156722] N78-21692
User's guide to the Nimbus-4 backscatter ultraviolet experiment data sets
[NASA-TM-78069] N78-21694

OZONOMETRY
An evaluation of electrochemical concentration Cell [ECC] sonde measurements of atmospheric ozone
[NASA-CR-2973] N78-21429

P

PACIFIC OCEAN
A statistical study of synoptic storm activity over the North Pacific in 1975
[AD-A050052] N78-21729
Dynamical numerical prediction of large-scale thermal anomalies in the North Pacific Ocean
[AD-A049919] N78-21740
Coastal upwelling ecosystems analysis, data report 39. Joint 2: R/V Thomas G. Thompson cruise 108 leg 1, CTD measurements off the coast of Peru near Cabo Nazca, April - May 1976
[PB-276532/9] N78-21742
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[PB-276533/7] N78-21743
Coastal upwelling ecosystems analysis. Technical report 34: Physical and biological measurements, 29 July - 5 August 1973
[PB-276486/8] N78-21746

PAINTS
Acceptance sampling of structural paints
[PB-275757/3] N78-21300

PANELS
Experimental and theoretical sound transmission --- reduction of interior noise in aircraft
[NASA-CR-156170] N78-21889

PARABOLAS
Parabolic profiling by the molecular stuffing process
N78-21908

PARABOLIC REFLECTORS
Compilation of wind tunnel coefficients for parabolic reflectors
[NASA-CR-156161] N78-21057

PARALLEL FLOW
Experimental study of the laminar-turbulent transition of a concave wall in a parallel flow
[NASA-TM-75243] N78-21412

PARAMETERIZATION
The modification and application of Kuo's parameterization of cumulus convection in middle latitudes
[NASA-CR-2998] N78-21717
Further progress on robust/resistant widthers
[AD-A049701] N78-21852

PARTIAL DIFFERENTIAL EQUATIONS
Boundary-dependent stability criteria for difference approximations of hyperbolic problems, 1
[AD-A049501] N78-21846
A minimum principle for the smallest eigenvalue for second order linear elliptic equations with natural boundary conditions
[AD-A050101] N78-21851

PARTICLE COLLISIONS
Inelastic collisions of excited atoms
[AD-A050037] N78-21901
Structure of multiply ionized heavy ions and associated collision phenomena
[AD-A049762] N78-21902

PARTICLE EMISSION
Survey and comparison of solar activity and energetic particle emission in 1970
[AD-A048479] N78-22013

PARTICLE FLUX DENSITY
A study of the propagation and intrinsic characteristics of flare-associated particle events
N78-22010

PARTICLE MASS
Binding energy and effectiveness mass of charged particles trapped on surfaces
[AD-A049945] N78-21964

PARTITIONS (MATHEMATICS)
Boolean algebras with partitioning bases
N78-21836

PASSENGER AIRCRAFT
Fire resistivity and toxicity studies of candidate aircraft passenger seat materials
[NASA-TM-78468] N78-21214

PATENTS
Technology assessment and forecast report, 8
[PB-276375/3] N78-21989

PATTERN RECOGNITION
Unstructured control and communication processes in real world scene analysis
[AD-A049458] N78-21352
A survey of computer architectures for image processing and pattern recognition
[AD-A049536] N78-21784
Thinning algorithms for grayscale pictures
[AD-A049587] N78-21800
Algorithms and hardware technology image recognition
[AD-A049590] N78-21803
Clustering edge values for threshold selection
[AD-A049592] N78-21823
Mosaic models for image analysis and synthesis
[AD-A050100] N78-21826
Interactive statistical software
[AD-A049707] N78-21874

PATTERN REGISTRATION
Some problems in assessing oculomotor activity during information retrieval
N78-21763

PAVEMENTS
Development of a pavement maintenance management system. Volume 2: Airfield pavement distress identification manual
[AD-A049029] N78-21170
Pavement heating: Executive summary
[PB-276504/8] N78-21327

PAYLOADS
A-4F Blue Angel flight usage data, 1976
[AD-A050164] N78-21100
Payload planning information development study
[NASA-CR-150633] N78-21175

PEELING
Flo-peeling and other alternatives to conventional turning
[AD-A050123] N78-21475

PENDULUMS
Torsional pendulum study on several epoxy/diamine polymers
[AD-A050478] N78-21299

PERCEPTION
Some problems in assessing oculomotor activity during information retrieval
N78-21763

PERFORATED SHELLS
On the question of equivalent reinforcement of holes in a shell --- using elastically deformed reinforcement rings
N78-21496

PERFORMANCE PREDICTION
A review of methodologies and concepts to measure and evaluate aircraft survivability/vulnerability
[AD-A050152] N78-21099
High temperature problems in gas turbine engines
[AGARD-CP-229] N78-21118
Performance measurements of the CVSD speech coding algorithm
[AD-A050163] N78-21362
Analytical models and experimental studies of centrifugal pump performance in two-phase flow. Key phase report
[EPRI-NP-170] N78-21477
Performance predictors for value engineering program management
[AD-A049696] N78-21972

PERFORMANCE TESTS
Orbiter S-band FM system console test procedure
[NASA-CR-151694] N78-21338
A 1/3 scale air-water pump program, analytical pump performance model. Volume 1: Key phase report
[EPRI-NP-160-VOL-1] N78-21478
Analysis of data and results for the roundrobin flat-plate collector test program
[PB-275576/7] N78-21655
American Air Filter Kinpactor 10 x 56 venturi scrubber evaluation
[PB-276716/8] N78-21682

PERIODIC FUNCTIONS
On the period of the coherent structure in boundary layers at large Reynolds numbers
[NASA-TM-78477] N78-21407

PERSPIRATION
Working in a hot environment; perspiration loss; a drink for persons working under hot conditions, part 2
[NASA-TM-75285] N78-21751

PERTURBATION THEORY
A perturbation method for predicting amplitudes of nonlinear wheel shimmy
N78-21464

PETROGRAPHY
Petrography and geochemistry of Precambrian rocks from GT-2 and EE-1
[LA-6930-MS] N78-21709

PHASE CONTROL
Large active retrodirective arrays for space applications
[NASA-CR-156163] N78-21333

PHASE DIAGRAMS
Composition of eta carbide in Hastelloy N after aging 10000 hr at 815 C
[ORNL-5340] N78-21283
Properties of new superconducting materials --- niobium and germanium compounds
[AD-A050296] N78-21959

PHASE SHIFT
An applied overview of moving boundary problems
[AD-A049695] N78-21962

PHASE TRANSFORMATIONS
Thermophysical properties and behavioral characteristics of phase-change materials
[CONF-770955-2] N78-21218

PHONONS
Generation and detection of microwave phonons in N-type indium antimonide
N78-21945

PHOTOCHEMICAL REACTIONS
Studies of flash-induced photoelectrochemical processes
N78-21229
Photochemical and kinetic studies of some metal dithizonate complexes
[AD-A049872] N78-21243
Development of a practical photochemical energy storage system
[SRO-893-6] N78-21626
Development of a practical photochemical energy storage system
[SRO-893-8] N78-21627
Development of a practical photochemical energy storage system
[SRO-893-9] N78-21628
Development of a practical photochemical energy storage system
[SRO-893-10] N78-21629

PHOTOCHROMISM
Photochemical and kinetic studies of some metal dithizonate complexes
[AD-A049872] N78-21243

PHOTOCONDUCTORS
Continued development of doped-germanium photoconductors for astronomical observations at wavelengths from 30 to 120 micrometers
[NASA-CR-152125] N78-22000

PHOTODIODES
High-resolution spectroscopy using tunable diode lasers: Techniques and applications
[LA-UR-77-2222] N78-21917

PHOTOELECTRIC EMISSION
Ultraviolet photoemission studies of formaldehyde and related molecules absorbed on Ru[110]
[AD-A049661] N78-21239
Photoemission studies of layered transition metal dichalcogenides
N78-21948

PHOTOGRAPHIC EQUIPMENT
Apollo over the moon: A view from orbit
[NASA-SP-362] N78-21174

PHOTOINTERPRETATION
LANDSAT and other sensor data for land-use planning in the Baltimore area
N78-21532
Interactive aids for cartography and photo interpretation
[AD-A049768] N78-21578

PHOTOMAPPING
Engineering study for pallet adapting the Apollo laser altimeter and photographic camera system for the Lidar Test Experiment on orbital flight tests 2 and 4
[NASA-CR-152615] N78-21525
Relationship of land use to water quality in the Chesapeake Bay region --- water sampling and photomapping river basins
N78-21544

PHOTOMETERS
Chemical array studies
[AD-A050024] N78-21577

PHOTONS
The evaluation and energy propagation of relativistic electron-nucleus Bremsstrahlung and virtual photon spectra
N78-21895

PHOTOVOLTAIC CELLS
Improved semiconductors for photovoltaic solar cells
[DSE/2460-2] N78-21646

PHYSICAL WORK
Cosmonaut work capacity in flight
N78-21762

PHYSIOLOGICAL EFFECTS
Germination of pine seed in weightlessness [investigation in Kosmos 782]
[NASA-TM-75281] N78-21172

PHYSIOLOGY
Aerospace Medicine and Biology: A continuing bibliography with indexes, supplement 178
[NASA-SP-7011(178)] N78-21750

PIGMENTS
Formulation of electrically conductive thermal-control coatings
[NASA-TP-1218] N78-21216

PILOT PLANTS
Prototype pilot plant operation: Synthane process
[COO-0003-8] N78-21316
Prototype pilot plant operation, synthane process
[COO-0003-10] N78-21317

PILOT TRAINING
Training device design: The simulation/ stimulation controversy
[AD-A049973] N78-21169

PIPE FLOW
Natural circulation calculation: Single-phase and two-phase flow in pipes
[DOE-TR-15] N78-21425

PIPELINES
Code of practice for welding. Part 5: Welders' competence tests for manual oxy-acetylene, manual metal-arc, manual gas-shielded tungsten-arc, and manual gas-shielded metal-arc welding of mild steel [carbon steel] and medium high tensile steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-5-1976-REV-1]
N78-21467
Code of practice for welding. Part 7: Welders' competence tests for manual metal-arc, manual inert gas-shielded tungsten-arc, and manual inert gas-shielded metal-arc welding of austenitic stainless and austenitic heat resisting steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-7-1976] N78-21468
Alaskan oil transportation issues
[PB-276449/6] N78-21661

PIPES (TUBES)
Fabrication of stainless steel clad tubing --- gas pressure bonding
[NASA-CP-135347] N78-21265
Code of practice for welding. Part 7: Welders' competence tests for manual metal-arc, manual inert gas-shielded tungsten-arc, and manual inert gas-shielded metal-arc welding of austenitic stainless and austenitic heat resisting steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-7-1976] N78-21468

PITTING
Pitting in aluminum --- copper cathode formation
[AD-A049854] N78-21274

PLANETARY EVOLUTION
Crustal evolution in the early earth: Basin-forming impacts, crustal dichotomy, and plate tectonics
N78-21685

PLANKTON
Coastal upwelling ecosystems analysis. Data report 41: Physical, chemical and biological observations

from JOINT 2 R/V ALPHA HELIX, Leg O, 5-20 March 1976
[PB-276297/9] N78-21745
PLANTS [BOTANY]
Germination of pine seed in weightlessness [investigation in Kosmos 782]
[NASA-TM-75281] N78-21172
Plant cover, soil temperature, freeze, water stress, and evapotranspiration
[E78-10101] N78-21509
PLASMA CLOUDS
High altitude limit of the gradient drift instability
[AD-A049503] N78-21698
PLASMA CONTROL
Design of an electrostatic end-plugged plasma-confinement device
[UCRL-79880] N78-21928
PLASMA DENSITY
Ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas
[NASA-CR-156068] N78-21924
PLASMA DYNAMICS
Some highlights of theoretical and computational plasma physics, part 2
[UCRL-79600-PT-2] N78-21936
PLASMA ELECTRODES
Effect of anode-cathode geometry on performance of the HIP-1 hot ion plasma --- magnetic mirrors
[NASA-TP-1201] N78-21922
PLASMA ENGINES
Pulsed plasma radio frequency interference studies
[AD-A049581] N78-21355
PLASMA HEATING
Study of possible separable solutions for plasma transport in ohmically heated Tokamaks
[ORNL/TM-6065] N78-21929
PLASMA INTERACTIONS
The Plasma Interaction Experiment (PIX) description and test program --- electrometers
[NASA-TM-78863] N78-21188
Investigation of high voltage spacecraft system interactions with plasma environments
[NASA-TM-78831] N78-21373
PLASMA JETS
Analytical capabilities of a dc plasma-echelle spectrometer system
N78-21230
PLASMA OSCILLATIONS
Induced oscillation instabilities and their role in Tokamaks with injected neutral particles
[ERDA-TR-312] N78-21932
PLASMA PHYSICS
Some highlights of theoretical and computational plasma physics, part 2
[UCRL-79600-PT-2] N78-21936
PLASMA WAVES
Theory and simulation of the stability of Bernstein-Greene-Kruskal waves --- vlasov equations and laplace transformation
N78-21918
PLASMAS [PHYSICS]
High energy ion expansion in laser-plasma interactions
[AD-A049504] N78-21446
Laser-fusion studies at NRL: A report to ERDA
[AD-A050089] N78-21451
Ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas
[NASA-CR-156068] N78-21924
Studies of parametric decay instabilities in magneto plasmas
[AD-A049547] N78-21925
PLASTIC DEFORMATION
Method of plastic deformation of metals and alloys
[AD-A049391] N78-21280
Experiments on viscoplastic response of circular plates to impulsive loading
[AD-A049866] N78-21502
PLASTICS
Complex loading of a composite material with a plastic matrix by torsion and tension
N78-21222
PLATES [STRUCTURAL MEMBERS]
Experimental investigation of the effects of fluid loading on flexural waves in plates
[AD-A050020] N78-21417
PLUG NOZZLES
Wind tunnel performance tests of coannular plug nozzles --- in the Langley 8 x 6 ft. supersonic wind tunnel
[NASA-CR-2990] N78-21044
PLUMES
Pretest information for a test to validate plume simulation procedures [FA-17]
[NASA-CR-150638] N78-21210
PNEUMATIC EQUIPMENT
Combustion properties of high density fuels --- liquid rocket propellant combustion simulation using pneumatic equipment
[AD-A050051] N78-21310
POLAR CAPS
Microwave emission from polar firn
[NASA-TP-1212] N78-21690
POLICIES
A turning point in space: Has the time arrived for a national review of our space policy
[AD-A049926] N78-21182
Simulation model for resource policy evaluation
[PB-275938/9] N78-21990
POLLUTION CONTROL
Environmental assessment of low/medium BTU gasification
[PB-276580/8] N78-21325
Inertial cascade impactor substrate media for flue gas sampling
[PB-276583/2] N78-21668
Century industrial products FRP-100 wet scrubber evaluation --- for air pollution control
[PB-276520/4] N78-21680
POLLUTION MONITORING
Remote in-situ elemental analysis systems for underwater application --- measuring pollutants in the chesapeake bay
N78-21546
Role of remote sensing in documenting land use as it affects the Bay and Bay use as it affects the land
N78-21556
Effluent monitoring procedures: Metals analyses. Student reference manual
[PB-275391/1] N78-21674
Effluent monitoring procedures: Metals analyses. Staff guide for conducting the course
[PB-275393/7] N78-21675
POLYCRYSTALS
An investigation of the influence of shock-wave profile on the mechanical and thermal responses of polycrystalline iron
[AD-A049764] N78-21278
POLYMER CHEMISTRY
High energy halogen chemistry --- propellants and explosives
[AD-A049555] N78-21240
POLYMERIC FILMS
Antifouling activity of phytotoxic compounds and experimental polymeric algicides
[MRL-R-698] N78-21747
POLYMERS
Relationships between structure and micromechanics of solvent crazes in glassy polymers
N78-21288
On the question of the fracture mechanism for solid polymers
N78-21290
Description of the temperature dependence of viscoelastic properties of polymers in the dynamic mode on the basis of linear thermoviscoelasticity theory
N78-21291
Certain results of determining the temperature dependences of the thermophysical characteristics of composite polymers
N78-21292
Stress relaxation in physically nonlinear polymer materials under combined tension with torsion
N78-21293
Torsional pendulum study on several epoxy/diamine polymers
[AD-A050478] N78-21299
POLYNOMIALS
An efficient algorithm for choosing the degree of a polynomial to approximate discrete nonoscillatory data
[NASA-TM-72854] N78-21839
POLYPROPYLENE
Investigation of the properties of the combustion products generated by building fires
[PB-276549/3] N78-21244
POLYVINYL CHLORIDE
Investigation of the properties of the combustion products generated by building fires
[PB-276549/3] N78-21244
PONDS
Use of LANDSAT data to assess waterfowl habitat quality
[E78-10120] N78-21524
POSITION [LOCATION]
A multi-sensor implementation for navigation, position location, position update, reconnaissance, and weapon delivery: AN/ARN-101[V]
N78-21082
POSITIONING
Applications of the NAVSTAR global positioning system to military guidance and control
N78-21085
POTABLE WATER
The cost of water supply and water utility management, volume 1
[PB-276639/2] N78-21992
The cost of water supply and water utility management, volume 2
[PB-276640] N78-21993
POWDER METALLURGY
Strength enhancement process for prealloyed powder superalloys
[NASA-TM-78834] N78-21266
POWER CONDITIONING
Mathematical simulation of power conditioning systems. Volume 1: Simulation of elementary units. Report on simulation methodology
[NASA-TM-75209] N78-21212
A 10kW lightweight dc converter: Technology feasibility study for lightweight megawatt range converters
[AD-A049937] N78-21384
POWER PLANTS
Thermal discharges and their role in pending power plant regulatory decisions
N78-21547
Work on power-plant [air] plumes involving remote sensing of SO2
N78-21548
Study of practical cycles for geothermal power plants
[COO-2619-1] N78-21651
POWER SUPPLY CIRCUITS
A 10kW lightweight dc converter: Technology feasibility study for lightweight megawatt range converters
[AD-A049937] N78-21384
PRECAMBRIAN PERIOD
Petrography and geochemistry of Precambrian rocks from GT-2 and EE-1
[LA-6930-MS] N78-21709
PRECIPITATION [METEOROLOGY]
Study of vertical movement and associative precipitation by extratropical perturbations in South America
[E78-10107] N78-21513
Orographic precipitation model for hydrometeorological use
N78-21714
Methods for estimating areal precipitation in mountainous areas
[PB-276140/1] N78-21731
PREDICTION ANALYSIS TECHNIQUES
A comparison between predicted and measured species concentrations and velocities in a research combustor
N78-21158
Shuttle orbiter - IUS/DSP satellite interface contamination study
[NASA-CR-151682] N78-21197
Correlation of laser velocimeter measurements over a wing with results of two prediction techniques --- in the Langley V/STOL tunnel
[NASA-TP-1168] N78-21410
PREDICTIONS
Earthquake prediction uncertainty, and policies for the future: A technology assessment of earthquake prediction
[PB-275581/7] N78-21713
PRESIDENTIAL REPORTS
National Science Foundation --- research projects and technology assessment
[NSF-77-1] N78-22018
PRESSURE
Pressure dependence of the elastic moduli of body-centered-cubic transition metals
N78-21943
PRESSURE DISTRIBUTION
Experimental investigation of effect of jet decay rate on jet-induced pressures on a flat plate
[NASA-CR-2979] N78-21096
Problems concerning high temperatures in small turbomachines
N78-21121
Investigation of the turbulent flows of two-phase media
[NASA-TT-F-17059] N78-21408
PRESSURE MEASUREMENTS
Transonic wind tunnel tests on two-dimensional aerofoil sections. Determination of pressure distribution and drag for an aerofoil with a modified NACA 65 sub2-215 section in FFA wind tunnel S5, part 2
[FFA-TN-AU-725] N78-21062
Transmission of impulse noise to the inner ear in the guinea pig by the recording of the intracochlear pressure. Evaluation of phenomena leading to injuries
[ISL-R-103/77] N78-21749
PRESSURE OSCILLATIONS
Non-radial p mode oscillations as a seismic probe of solar structure
N78-22008
PRESSURE PULSES
Transient response of two fluid-coupled spherical elastic shells to an incident pressure pulse
[AD-A049443] N78-21497
PRESSURE SENSORS
Test and development of inflatable spheres instrumented with miniaturized thermistors, accelerometers and pressure transducers
[NASA-CR-2968] N78-21428
PRINTED CIRCUITS
Quantification of printed circuit board [PCB] connector reliability
[AD-A049980] N78-21378
Low profile, printed circuit antennas
[AD-A047629] N78-21389

PROBABILITY DENSITY FUNCTIONS
Estimation of the operating characteristics of item response categories. 1: Introduction to the two-parameter beta method
[AD-A049618] N78-21873
Axiomatic characterization of a family of information measures that contains the directed divergences
[AD-A050096] N78-21983
PROBABILITY DISTRIBUTION FUNCTIONS
A study of renewal processes with IMRL and DFR interarrival times
[AD-A049989] N78-21875
PROBLEM SOLVING
A computer program for solving learning curve problems
[AD-A049917] N78-21812
PROCUREMENT POLICY
Federal agencies should be given multiyear contracting authority for supplies and services
[PB-276028/8] N78-21978
PROFILES
Design of two high gain, low profile helical antennas for operation at 918 MHz
[AD-A049950] N78-21386
PROFILOMETERS
Runway roughness evaluation laser profilometer implementation study
[AD-A049440] N78-21165
PROGRAM VERIFICATION (COMPUTERS)
Software engineering. Volume 1: Its development and standards
[AD-A049869] N78-21813
PROGRAMMING LANGUAGES
Communications high-order language investigation, volume 1
[AD-A049737] N78-21340
Communications high-order language investigation, volume 2
[AD-A049736] N78-21341
Improvements to SEMANOL, volume 1
[AD-A049472] N78-21793
SEMANOL [76] reference manual, volume 2
[AD-A049473] N78-21794
SEMANOL [76] specification of Jovial [J3], volume 3
[AD-A049474] N78-21795
SEMANOL [76] interpreter documentation, volume 4
[AD-A049475] N78-21796
PROGRAMS
A range of cost measuring risk and uncertainty in major programs: An aid to decision making — for federal funding
[PB-276384/5] N78-21979
PROJECT MANAGEMENT
Operational programs in forest management and priority in the utilization of remote sensing
N78-21531
Performance predictors for value engineering program management
[AD-A049696] N78-21972
PROJECT PLANNING
Active microwave users working group program planning
N78-21566
The First Seasat-A Industrial Users Workshop
[NASA-CR-156149] N78-21573
PROJECTILES
Experiments related to external burning for propulsion
[AD-A047623] N78-21241
PROPAGATION
A study of the propagation and intrinsic characteristics of flare-associated particle events
N78-22010
PROPANE
A comparison between predicted and measured species concentrations and velocities in a research combustor
N78-21158
PROPELLANT CHEMISTRY
High energy halogen chemistry — propellants and explosives
[AD-A049555] N78-21240
PROPELLANT COMBUSTION
Combustion properties of high density fuels — liquid rocket propellant combustion simulation using pneumatic equipment
[AD-A050051] N78-21310
PROPELLANT GRAINS
Propellant burning rate and combustion uniformity identified by ultrasonic acoustic emissions
[AD-A049942] N78-21308
PROPELLANT TESTS
Analysis and test for space shuttle propellant dynamics: 1/60th scale model test results
[NASA-CR-151681] N78-21301
PROPULSION SYSTEM CONFIGURATIONS
Evolution of the 1-mlb mercury ion thruster subsystem
[NASA-TM-73733] N78-21202
PROPULSION SYSTEM PERFORMANCE
Airflow and thrust calibration of an F100 engine, S/N P680059, at selected flight conditions
[NASA-TP-1069] N78-21112
Planned flight test of a mercury ion auxiliary propulsion system. 1: Objectives, systems descriptions, and mission operations
[NASA-TM-78859] N78-21204
PROTECTION
Protection of cooled blades of complex internal structure
N78-21141
PROTECTIVE COATINGS
Progress in advanced high temperature turbine materials, coatings, and technology
N78-21122
Cobalt-base alloys for hot corrosion protective coatings
N78-21142
PROTOTYPES
Prototype pilot plant operation: Synthane process
[COO-0003-8] N78-21316
Prototype pilot plant operation, synthane process
[COO-0003-10] N78-21317
Development of prototype air/liquid solar collector subsystem
[NASA-CR-150627] N78-21604
PROVING
Pretest information for a test to validate plume simulation procedures [FA-17]
[NASA-CR-150638] N78-21210
PSYCHOLOGICAL TESTS
Motivation and intensionality in a computer simulation model
N78-21790
PSYCHOLOGY
Aerospace Medicine and Biology: A continuing bibliography with indexes, supplement 178
[NASA-SP-7011[178]] N78-21750
PULMONARY FUNCTIONS
Microprocessor-based cardiopulmonary monitoring system
[NASA-CR-151688] N78-21752
PULSE AMPLITUDE
Evaluation of flaw indications by ultrasonic pulse amplitude and phase spectroscopy
[ORNL-TR-4355] N78-21484
PULSE COMMUNICATION
Signal-to-noise ratio estimation in digital computer simulation of lowpass and bandpass systems with applications to analog and digital communications
N78-21329
Synthesis and analysis of precise spaceborne laser ranging systems, volume 1 — link analysis
[NASA-CR-156727] N78-21442
Synthesis and analysis of precise spaceborne laser ranging systems, volume 2 — Spacelab payload
[NASA-CR-156728] N78-21443
PULSE GENERATORS
Pulsed plasma radio frequency interference studies
[AD-A049581] N78-21355
Current pulse generator with amplitude of 1,000,000 A and stability of plus or minus .001 at a repetition rate of two Hz
[AD-A049390] N78-21390
Pulse applications and parameter identification for US Navy medium-weight shock machine
[AD-A050120] N78-21500
PUMPS
A 1/3 scale air-water pump program, analytical pump performance model. Volume 1: Key phase report
[EPRI-NP-160-VOL-1] N78-21478
PUPILLOMETRY
Pupillometric signs of brain activation vary with level of cognitive processing
[AD-A050029] N78-21757
Activation and sustained attention: A pupillometric study of an auditory vigilance task
[AD-A050040] N78-21759
PYROLYSIS
Oxidation kinetics of hydrocarbon fuels
[AD-A050056] N78-21311

Q

QUADRATIC EQUATIONS
A double integral quadratic cost problem with application to feedback stabilization
[AD-A049533] N78-21822
Direct transformation of variational problems into cauchy systems. 2: Scalar-semi-quadratic case
[AD-A049527] N78-21848
QUADRATIC PROGRAMMING
An alternative method for a global analysis of quadratic programs in a finite number of steps
[AD-A049756] N78-21805
QUANTITATIVE ANALYSIS
Quantitative determination of surface temperatures using an infrared camera
[CONF-770868-2] N78-21916
QUANTUM MECHANICS
Free electron laser theory
N78-21437
QUANTUM THEORY
Research investigation directed toward extending the useful range of the electromagnetic spectrum
[NASA-CR-156069] N78-21236
Free electron laser theory
N78-21437
QUENCHING (COOLING)
The effect of varying quench rates and heating rates on the aging response of an aluminum powder alloy
[AD-A049744] N78-21272
QUEUEING THEORY
Optimal dispatching of a finite capacity shuttle
[AD-A049595] N78-21824
CMS histogram, density estimation and probability plotting routines, with an application to the analysis of the output of assimulation of a correlated queue
[AD-A050213] N78-21827

R

RADAR
An analysis of multi-frequency high resolution radar rain rate data
[NASA-CR-156734] N78-21337
Synthetic Aperture Radar [SAR] data processing
N78-21567
RADAR ECHOES
Range resolution of targets using automatic detectors
[AD-A049442] N78-21348
RADAR EQUIPMENT
Unattended/minimally attended radar study. Volume 1: Summary
[AD-A049776] N78-21346
Unattended/minimally attended radar study, volume 2
[AD-A049777] N78-21347
RADAR IMAGERY
Analysis of synthetic aperture radar imagery
[NASA-CR-156743] N78-21339
Applications of active microwave imagery
N78-21564
RADAR TRACKING
Improved aircraft tracking using maneuver statistics enroute and in the terminal area
N78-21087
RADIAL DISTRIBUTION
Ball to separator contact forces in angular contact ball bearings under thrust and radial loads
[NASA-CR-2976] N78-21469
RADIATION DISTRIBUTION
Local flame temperature measurements by radiative methods
N78-21153
RADIATION EFFECTS
Division 2: Materials in space engineering. Chapter 3: Influence of the space medium on materials
N78-21178
Radiation characterization of sequential logic circuits
[AD-A050476] N78-21388
Investigations of the biological effects of radiation: A multi-discipline approach
[COO-2486-366] N78-21760
RADIATION HAZARDS
Biological applications and effects of optical masers
[AD-A050057] N78-21462
RADIATION SHIELDING
Diagnostic evaluations of a beam-shielded 8-cm mercury ion thruster
[NASA-TM-78855] N78-21207
RADIATIVE TRANSFER
Approximate solutions to the radiative transfer equation using the Elsasser scheme
[AD-A049933] N78-21703
Ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas
[NASA-CR-156068] N78-21924
High thermal efficiency, radiation-based advanced fusion reactors
[EPRI-ER-544] N78-21926
RADII
Small inner spherical radius sweep gage
[MHSMP-77-5G] N78-21434
RADIO BEACONS
Special study: Emergency locator transmitters, an overview
[NTSB-AAS-78-1] N78-21063
RADIO COMMUNICATION
The Joint Tactical Information Distribution System (JTIDS)
N78-21086
A report on the Chesapeake Bay region NOW-CASTING experiment
[PB-277102/0] N78-21732
RADIO FREQUENCY INTERFERENCE
Pulsed plasma radio frequency interference studies
[AD-A049581] N78-21355
RADIO FREQUENCY SHIELDING
Pulsed plasma radio frequency interference studies
[AD-A049581] N78-21355
RADIO WAVES
Ionospheric reflection and absorption properties of normal modes at ELF
[AD-A049778] N78-21702

RADIOACTIVITY
Study of soft alkaline using LANDSAT images of pools and residue with an emphasis on radioactive materials n-- Brazil
[E78-10104] N78-21510
RADIOGRAPHY
Protection of the cardiopulmonary systems against the injurious effects of acceleration
[AD-A050142] N78-21755
Radiographic and biomechanical studies of the human spine
[AD-A049984] N78-21758
RADIOMETERS
APL radiometer wind tunnel test program
[BSR-4188] N78-21401
APL radiometer wind tunnel test program with simulated aircraft radome
[BSR-4230] N78-21402
Tunable diode laser heterodyne spectrometer for balloon-borne solar radiometry in the stratosphere
[SAND-77-0601] N78-21463
RADOMES
APL radiometer wind tunnel test program with simulated aircraft radome
[BSR-4230] N78-21402
RAIN
An analysis of multi-frequency high resolution radar rain rate data
[NASA-CR-156734] N78-21337
Analysis of global oceanic rainfall from microwave data
[NASA-CR-156737] N78-21719
RAMAN LASERS
Experimental determination of nonlinear constants for self-focusing and stimulated Raman emission
N78-21438
RAMJET ENGINES
Rectangular capture area to circular combustor scramjet engine
[NASA-TM-78657] N78-21107
RANDOM NOISE
The calculation of RMS values of deviations of aircraft controlled to fly along a desired flight path
N78-21084
RANDOM PROCESSES
The comprehension factor in randomized response
N78-21869
Randomized response designs
N78-21871
RANDOM VARIABLES
A non-linear renewal theory with applications to sequential analysis, 2
[AD-A049783] N78-21864
Convergence of weighted sums of random elements and statistical applications
N78-21872
On the convolution of logistic random variables
[AD-A049996] N78-21876
RANDOM WALK
Stationary stochastic and discrete Markov process. Part 1: The range of a strictly stationary stochastic process. Part 2: Some additional results concerning limits of a discrete Markov process
N78-21868
RANGE (EXTREMES)
Extremal problems in quasiconformal mappings with side conditions
N78-21831
Stationary stochastic and discrete Markov process. Part 1: The range of a strictly stationary stochastic process. Part 2: Some additional results concerning limits of a discrete Markov process
N78-21868
RANGEFINDING
One-way ranging with TACAN
N78-21079
An ECM-resistant communication and ranging system for remotely piloted vehicles
N78-21080
RANKINE CYCLE
Modeling of Rankine cycle/vapor compression cycle cooling systems for solar energy applications
N78-21587
RANKING
A method for assessment of the natural variability found in hurricanes through use of ranking techniques and nonparametric statistics
[PB-276430/6] N78-21733
RARE EARTH ELEMENTS
Preparation of rare earth doped laser materials
[AD-A049697] N78-21454
Structural and magnetic studies of selected rare earth intermetallics
N78-21949
RARE GASES
Study of metastable rare gas collisions with halogens
[AD-A049829] N78-21449
Vacuum ultraviolet and visible radiation from electron impact excitation of nitrogen, hydrogen, oxygen, the light hydrocarbons and the rare gases
N78-21897
RAREFIED GASES
Heat transfer in continuum and rarefied gases
N78-21399
REACTION KINETICS
Photochemical and kinetic studies of some metal dithizonate complexes
[AD-A049872] N78-21243
Fundamental and semi-global kinetic mechanisms of hydrocarbon combustion
[COO/4272-1] N78-21245
Thermochemistry and kinetics of sulfur containing molecules and radicals
[PB-275721/9] N78-21247
Oxidation kinetics of hydrocarbon fuels
[AD-A050056] N78-21311
Kinetics of model chemical reactions
N78-21894
REACTOR SAFETY
Loose-parts monitoring: Present status of the technology, its implementation in US reactors, and some recommendations for achieving improved performance
[CONF-770902-5] N78-21483
General-purpose heat source project, space nuclear safety program, and radioisotopic terrestrial safety program
[LA-7003-PR] N78-21906
REACTOR TECHNOLOGY
High thermal efficiency, radiation-based advanced fusion reactors
[EPRI-ER-544] N78-21926
READOUT
Thermocouple readout instrument
[PB-275429/9] N78-21436
Hard X-ray imaging facility for space shuttle: A scientific and conceptual engineering study
[NASA-CR-156736] N78-22016
REAL NUMBERS
Scientific calculating system with a number-oriented microprocessor sequenced by a single component microcomputer
[LA-UR-2383] N78-21789
REAL TIME OPERATION
Real-time, intermediate-field astrometry
[AD-A048155] N78-22001
REAL VARIABLES
Distribution of a sum of weighted chi-square variables
[AD-A049986] N78-21855
RECOMBINATION REACTIONS
Ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas
[NASA-CR-156068] N78-21924
RECONNAISSANCE
A multi-sensor implementation for navigation, position location, position update, reconnaissance, and weapon delivery: AN/ARN-101(V)
N78-21082
RECONNAISSANCE SPACECRAFT
Satellite surveillance avoidance optimization aid --- for naval operations
[AD-A049561] N78-21195
RECTIFIERS
A 10kW lightweight dc converter: Technology feasibility study for lightweight megawatt range converters
[AD-A049937] N78-21384
RECURSIVE FUNCTIONS
The convergence of functions to fixed points of recursive definitions
[AD-A049760] N78-21866
RECYCLING
Dynamic hyperfiltration membranes for high-temperature spacecraft wash water recycle
[NASA-CR-151689] N78-21767
REFLECTANCE
Inventory of forest resources [including water] by multi-level sampling --- nine northern Virginia coastal plain counties
[E78-10118] N78-21522
Internal reflection of bounded beams: Effects in the plane of incidence
N78-21910
REFLECTORS
Efficient computation of radiation patterns and contour beam synthesis using reflector antennas
[AD-A050132] N78-21361
REFRACTIVITY
The radio climatology of Canada. Tropospheric refractivity atlas for Canada
[CRC-1315-E] N78-21689
USMR [White Sands Missile Range] atmospheric structure constant [C sub n, sup 2] survey
[PB-276097/3] N78-21711
REFRACTORY MATERIALS
Progress in advanced high temperature turbine materials, coatings, and technology
N78-21122
REGIONAL PLANNING
Regional energetic coupling of man and his environment: Data requirements --- regional planning and ecosystems
N78-21543
Energy supply and environmental impacts: Conventional energy sources
[PB-276410/8] N78-21669
REGRESSION ANALYSIS
On a measure of lack of fit in time series models
[AD-A049397] N78-21860
REINFORCED SHELLS
On the question of equivalent reinforcement of holes in a shell --- using elastically deformed reinforcement rings
N78-21496
REINFORCEMENT RINGS
On the question of equivalent reinforcement of holes in a shell --- using elastically deformed reinforcement rings
N78-21496
RELATIVISTIC PARTICLES
The evaluation and energy propagation of relativistic electron-nucleus Bremsstrahlung and virtual photon spectra
N78-21895
RELIABILITY
Unattended/minimally attended radar study. Volume 1: Summary
[AD-A049776] N78-21346
Unattended/minimally attended radar study, volume 2
[AD-A049777] N78-21347
A study of renewal processes with IMRL and DFR interarrival times
[AD-A049989] N78-21875
REMOTE CONSOLES
Continued implementation and testing of a Neighborhood Office Center [NOC] and integration of the NOC with an administrative correspondence management information system
[NASA-CR-156150] N78-21970
REMOTE CONTROL
Visual-proprioceptive cue conflicts in the control of remotely piloted vehicles
[AD-A049706] N78-21770
REMOTE HANDLING
Collision detection and avoidance in computer controlled manipulators
N78-21766
REMOTE SENSORS
Heat Capacity Mapping Mission [HCMM] launch
[NASA-TM-79429] N78-21191
Application of Remote Sensing to the Chesapeake Bay Region. Volume 2: Proceedings
[NASA-CP-6] N78-21526
The Chesapeake Bay: Our regional resource
N78-21527
The Chesapeake Bay Program: An opportunity to use an innovative monitoring technique
N78-21528
Present status of LANDSAT remote sensing
N78-21529
Activities of the US Geological Survey in Applications of Remote Sensing in the Chesapeake Bay Region
N78-21530
Operational programs in forest management and priority in the utilization of remote sensing
N78-21531
LANDSAT and other sensor data for land-use planning in the Baltimore area
N78-21532
Remote sensing, geology, and land use
N78-21533
Maryland Automated Geographic Information System
N78-21534
The Chesapeake Bay: A challenge to the remote sensing community
N78-21535
Mission of a remote sensing center
N78-21536
Use of remote sensing technology provided by the NASA/WFC Chesapeake Bay Ecological Program
N78-21538
LANDSAT sensors
N78-21540
Remote sensing of water quality
N78-21541
Acoustic remote probing of the environment --- atmospheric and underwater acoustic data acquisition
N78-21542
Remote in-situ elemental analysis systems for underwater application --- measuring pollutants in the chesapeake bay
N78-21546
Work on power-plant [air] plumes involving remote sensing of SO2
N78-21548
Lidar: A laser technique for remote sensing
N78-21549
Inferring nutrient loading of estuarine systems by remote sensing of aquatic vegetation
N78-21552
Contribution of remote sensing to understand the Bay as a system
N78-21553
Role of remote sensing in documenting living resources
N78-21554
Use of remote sensing in facility siting
N78-21555
Role of remote sensing in documenting land use as it affects the Bay and Bay use as it affects the land
N78-21556

Role of remote sensing in Bay measurements
N78-21557
Possible role of remote sensing for increasing public awareness of the Chesapeake Bay environment
N78-21558
NCSL task force findings on feasible state uses of LANDSAT
N78-21559
Progress toward a circulation atlas for application to coastal water siting problems
[VIMS-CONTRIB-823] N78-21560
Application of a computerized environmental information system to master and sector planning
N78-21561
Active Microwave Users Workshop Report
[NASA-CP-2030] N78-21562
Active microwave users working group program planning
N78-21566
A model of the 0.4-GHz scatterometer — used for agriculture soil moisture program
[NASA-CR-151693] N78-21574
Use of satellite images in the evaluation of farmlands — in Mexico
[NASA-TM-75088] N78-21575
Distributed sensor networks
[AD-A050160] N78-21576
Remote sensing of Gulf Stream using GEOS-3 radar altimeter
[NASA-TP-1209] N78-21737

REMOTELY PILOTED VEHICLES
An ECM-resistant communication and ranging system for remotely piloted vehicles
N78-21080

REPRODUCTION [COPYING]
Transcript of National Commission on New Technological uses of copyrighted works
[PB-275786/2] N78-21987

RESCUE OPERATIONS
Special study: Emergency locator transmitters, an overview
[NTSB-AAS-78-1] N78-21063

RESEARCH AND DEVELOPMENT
The quality of NOAA's ocean research and development program: An evaluation
[PB-277095/6] N78-21980

RESEARCH FACILITIES
Mission of a remote sensing center
N78-21536

RESEARCH MANAGEMENT
Mission of a remote sensing center
N78-21536
The quality of NOAA's ocean research and development program: An evaluation
[PB-277095/6] N78-21980

RESEARCH PROJECTS
National Science Foundation — research projects and technology assessment
[NSF-77-1] N78-22018

RESERVES
Helium: A public policy problem
[PB-276040/3] N78-21585

RESERVOIRS
Results of reservoir evaluation tests, 1976 East Mesa Geothermal Field, California
[LBL-6369] N78-21631

RESOLUTION
Range resolution of targets using automatic detectors
[AD-A049442] N78-21348

RESOURCES MANAGEMENT
An integrated study of earth resources in the state of California using remote sensing techniques
[E78-10115] N78-21520
The Chesapeake Bay: Our regional resource
N78-21527
The Chesapeake Bay Program: An opportunity to use an innovative monitoring technique
N78-21528
Distributed technologies in California's energy future, volume 1
[LBL-6831-VOL-1] N78-21623
Simulation model for resource policy evaluation
[PB-275938/9] N78-21990
National Science Foundation — research projects and technology assessment
[NSF-77-1] N78-22018

RESPONSES
Randomized response designs
N78-21871

RETINA
Biological applications and effects of optical masers
[AD-A050057] N78-21462

RETIREMENT
Factors affecting the retirement of commercial transport jet aircraft
[NASA-CR-152115] N78-21092

REVERSED FLOW
Evaluation of a ceramic combustion chamber for a small gas turbine engine
N78-21145

RHENIUM
Mechanism of the decomposition of ethylene at low pressure on the surface of rhenium ribbon at high temperature, 2
[BNWL-TR-254] N78-21246

RING LASERS
Optically pumped mercury lasers for ring laser gyroscope applications
[AD-A049540] N78-21455

RISK
Earthquake prediction uncertainty, and policies for the future: A technology assessment of earthquake prediction
[PB-275581/7] N78-21713
A range of cost measuring risk and uncertainty in major programs: An aid to decision making — for federal funding
[PB-276384/5] N78-21979

RIVER BASINS
LANCHAD: Remote sensing of the N'Djamena area and the Logone-Chari confluent
[NASA-TM-75087] N78-21570

RIVERS
Coastal wetlands along Lake Ontario and the St. Lawrence in Jefferson County, New York
[PB-276031/2] N78-21744

RIVETED JOINTS
Studies on the failure of metal mechanical joints subjected to dynamic loads
[AD-A050076] N78-21503

ROCKET ENGINES
Evolution of the 1-mlb mercury ion thruster subsystem
[NASA-TM-73733] N78-21202
Planned flight test of a mercury ion auxiliary propulsion system. 1: Objectives, systems descriptions, and mission operations
[NASA-TM-78859] N78-21204
The 5200 cycle test of an 8-cm diameter Hg ion thruster
[NASA-TM-78860] N78-21208

ROCKET EXHAUST
Pretest information for a test to validate plume simulation procedures [FA-17]
[NASA-CR-150638] N78-21210
Unsteady plume and blast field generated by a rocket launch
[AD-A050000] N78-21213
Atmospheric scavenging of solid rocket exhaust effluents
[NASA-CR-2997] N78-21665

ROCKET LAUNCHING
Unsteady plume and blast field generated by a rocket launch
[AD-A050000] N78-21213
The 14821A Lance missile no. 3294, round no. 301 APL, 5 October 1977
[AD-A049431] N78-21727
The 14823A Lance missile no. 3293, round no. 300 AST 5 October 1977
[AD-A049430] N78-21728

ROLL FORMING
Structure of deformed silicon and implications for low cost solar cells
[NASA-CR-156166] N78-21600

ROLLING
Rolling-element fatigue life of AISI M-50 and 18-4-1 balls
[NASA-TP-1202] N78-21473

ROOTS OF EQUATIONS
On Nth roots of positive operators
[NASA-CR-151697] N78-21841

ROTATING BODIES
Simplified model of statistically stationary spacecraft rotation and associated induced gravity environments
[NASA-TM-78164] N78-21198

ROTATING CYLINDERS
Flow and heat transfer in rotating coolant channels
N78-21156

ROTATING DISKS
Calculation of temperature distribution in disks and cooling flow in a transient state
N78-21157

ROTATING ENVIRONMENTS
Simplified model of statistically stationary spacecraft rotation and associated induced gravity environments
[NASA-TM-78164] N78-21198

ROTOR BLADES [TURBOMACHINERY]
Heat transfer to a PVD rotor blade at high subsonic passage throat Mach numbers
N78-21150
A note on multicyclic control by swashplate oscillation
[NASA-TM-78475] N78-21159

RUBY LASERS
Long-range holography field experiments
[AD-A050122] N78-21433

RUNWAYS
Runway roughness evaluation laser profilometer implementation study
[AD-A049440] N78-21165
Development of a pavement maintenance management system. Volume 2: Airfield pavement distress identification manual
[AD-A049029] N78-21170

RUTHENIUM
Ultraviolet photoemission studies of formaldehyde and related molecules absorbed on Ru[110]
[AD-A049661] N78-21239

S

SAFETY FACTORS
Safety evaluation of distress flares and smokes
[AD-A049969] N78-21309

SALYUT SPACE STATION
Translations on USSR science and technology: Physical sciences and technology, no. 33
[JPRS-70946] N78-21183
Laboratory in space — Salyut-6 space station
N78-21185

SAMPLING
Time- and space-resolved species determination in diesel combustion using continuous flow gas sampling
N78-21227
Acceptance sampling of structural paints
[PB-275757/3] N78-21300
Design of interactive manufacturing and quality systems subject to inspection error using dynamic programming
N78-21481

SATELLITE ATTITUDE CONTROL
A satellite control problem
[AD-A049510] N78-21194
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10105] N78-21511

SATELLITE CONFIGURATIONS
Shuttle orbiter - IUS/DSP satellite interface contamination study
[NASA-CR-151682] N78-21197

SATELLITE NAVIGATION SYSTEMS
Applications of the NAVSTAR global positioning system to military guidance and control
N78-21085

SATELLITE OBSERVATION
NCSL task force findings on feasible state uses of LANDSAT
N78-21559
Summary of the active microwave users workshop
N78-21563
Use of satellite images in the evaluation of farmlands — in Mexico
[NASA-TM-75088] N78-21575
World weather program. Plan for fiscal year 1978
[PB-276479/3] N78-21718

SATELLITE SOLAR ENERGY CONVERSION
Solar power satellites
[NASA-TM-79434] N78-21612

SATELLITE SOLAR POWER STATIONS
Construction in space: A proposed experiment in support of the space solar power concept and other large space systems
[NASA-TM-79435] N78-21179
Solar power satellites
[NASA-TM-79434] N78-21612

SATELLITE TRACKING
A runaway satellite is going to crash 20 April — Cosmos 849 satellite
N78-21184
Ionospheric effects on the Doppler frequency shift in SARSAT propagation
[CRC-1313] N78-21334

SATELLITE-BORNE INSTRUMENTS
Active Microwave Users Workshop Report
[NASA-CP-2030] N78-21562

SATELLITE-BORNE PHOTOGRAPHY
The use of satellite imagery for highway engineering in overseas countries
[PB-276669/9] N78-21328

SATELLITE-BORNE RADAR
Speckle noise in satellite based lidar systems
[NASA-CR-156723] N78-21444

SCALE MODELS
Subsonic longitudinal and lateral-directional static aerodynamic characteristics for a close-coupled wing-canard model in both swept back and swept forward configurations
[NASA-TM-74092] N78-21049
Effect of leading-edge contour and vertical-tail configuration on the low-speed stability characteristics of a supersonic transport model having a highly-swept arrow wing
[NASA-TM-78683] N78-21051
Analysis and test for space shuttle propellant dynamics: 1/60th scale model test results
[NASA-CR-151681] N78-21301

SCALERS
Direct transformation of variational problems into Cauchy systems. 1: Scalar-quadratic case
[AD-A049526] N78-21847

SCALING LAWS
Scaling of cavitation damage
[AD-A049766] N78-21419

SCANDIUM OXIDES
Study of diatomic molecules. 2: Intensities — optical emission spectroscopy of ScO
[NASA-TM-75290] N78-21900

SCANNERS
A scanning ion microscope with a field ionization source
N78-21909

SCANNING
Associative array processing of raster scanned data for automated cartography II: Improved resolution and data handling
[AD-A049698] N78-21379
SCATTERING CROSS SECTIONS
Experimental and theoretical studies of ion-molecule scattering
N78-21898
SCATTEROMETERS
A model of the 0.4-GHz scatterometer --- used for agriculture soil moisture program
[NASA-CR-151693] N78-21574
SCAVENGING
Atmospheric scavenging of solid rocket exhaust effluents
[NASA-CR-2997] N78-21665
SCENE ANALYSIS
Unstructured control and communication processes in real world scene analysis
[AD-A049458] N78-21352
SCHEDULING
Multi-item scheduling in reparable item inventory systems with reflection programming
[AD-A049553] N78-21808
Algorithms for computing repair schedules in probabilistic environments
[AD-A049554] N78-21809
Optimal dispatching of a finite capacity shuttle
[AD-A049595] N78-21824
SCRUBBERS
Century industrial products FRP-100 wet scrubber evaluation --- for air pollution control
[PB-276520/4] N78-21680
American Air Filter Kinpactor 10 x 56 venturi scrubber evaluation
[PB-276716/8] N78-21682
SEA STATES
Theoretical study to determine the sea state limit for the survival of oil slicks on the ocean
[AD-A049794] N78-21666
SEA WATER
Antifouling activity of phytotoxic compounds and experimental polymeric algicides
[MRL-R-698] N78-21747
SEALS [STOPPERS]
Gas path sealing in turbine engines
[NASA-TM-73890] N78-21109
SEARCH PROFILES
Multicriteria integer zero-one programming: A tree-search type algorithm
[AD-A050244] N78-21807
SEARCHING
Special study: Emergency locator transmitters, an overview
[NTSB-AAS-78-1] N78-21063
SEASAT PROGRAM
Seasat land experiments
N78-21565
SEASAT-A SATELLITE
Seasat land experiments
N78-21565
The First Seasat-A Industrial Users Workshop
[NASA-CR-156149] N78-21573
SEATS
Fire resistivity and toxicity studies of candidate aircraft passenger seat materials
[NASA-TM-78468] N78-21214
SECONDARY FLOW
FLOWNET: A computer program for calculating secondary flow conditions in a network of turbomachinery
[NASA-TM-73774] N78-21791
SEISMIC WAVES
Interpretation of single-channel seismic reflection records
[AD-A047511] N78-21696
Seismic studies of surface and body waves for improved yield determination
[AD-A049958] N78-21705
Non-radial p mode oscillations as a seismic probe of solar structure
N78-22008
SEISMOLOGY
Seismic studies of surface and body waves for improved yield determination
[AD-A049958] N78-21705
SELECTION
A note on the use of second-order gray level statistics for threshold selection
[AD-A049454] N78-21820
SELF FOCUSING
Experimental determination of nonlinear constants for self-focusing and stimulated Raman emission
N78-21438
SEMANTICS
Research in natural language understanding
[AD-A049781] N78-21810
SEMICONDUCTOR DEVICES
Light activated semiconductor switches
[UCRL-80046] N78-21393
Optical-microwave interactions in semiconductor devices
[AD-A050480] N78-21458
SEMICONDUCTOR JUNCTIONS
Light activated semiconductor switches
[UCRL-80046] N78-21393
Performance limits of a Josephson junction mixer
[AD-A049544] N78-21963
SEMICONDUCTORS [MATERIALS]
Activation analysis of admixtures in certain semiconductive materials
[NASA-TM-75258] N78-21231
Improved semiconductors for photovoltaic solar cells
[DSE/2460-2] N78-21646
Electroreflectance in semiconductors and its application as a method of materials characterization
N78-21950
SENSORIMOTOR PERFORMANCE
Effects of ethanol on visual unit activity in the thalamus
[AD-A050922] N78-21754
SEPARATORS
Ball to separator contact forces in angular contact ball bearings under thrust and radial loads
[NASA-CR-2976] N78-21469
Energy oriented study of industrial cyclone separators
[TREE-1174] N78-21642
SEQUENCING
Confidence intervals related to sequential tests for the exponential distribution
[AD-A049758] N78-21863
A non-linear renewal theory with applications to sequential analysis, 2
[AD-A049783] N78-21864
Estimation following sequential tests
[AD-A049784] N78-21880
Averaging in Banach spaces
N78-21887
SEQUENTIAL ANALYSIS
Asymptotic distribution of symmetric statistics
[AD-A049395] N78-21862
The convergence of functions to fixed points of recursive definitions
[AD-A049760] N78-21866
SEQUENTIAL COMPUTERS
Scientific calculating system with a number-oriented microprocessor sequenced by a single component microcomputer
[LA-UR-2383] N78-21789
SEQUENTIAL CONTROL
Nonparametric procedures for process control
N78-21870
SERVICE LIFE
Project optimisation of military gas turbines with respect to turbine life
N78-21120
SHAFTS [MACHINE ELEMENTS]
Rolling-element fatigue life of AISI M-50 and 18-4-1 balls
[NASA-TP-1202] N78-21473
SHEAR FLOW
Shear dispersion in time-varying flows
[PB-277103/8] N78-21421
SHEAR PROPERTIES
A biaxial method for inplane shear testing --- shear strain in composite materials
[NASA-TM-74070] N78-21489
Simple torsion test for shear moduli determination of orthotropic composites
[NASA-TM-78485] N78-21490
SHEAR STRAIN
A biaxial method for inplane shear testing --- shear strain in composite materials
[NASA-TM-74070] N78-21489
SHEAR STRENGTH
Shear strength of fillet welds in aluminum alloy 2219 --- for use on the solid rocket motor and external tank
[NASA-TM-78168] N78-21495
SHEARS
Drift waves in inhomogeneous plasmas with shear and temperature gradients
N78-21919
SHELLS [STRUCTURAL FORMS]
Dynamic instability analysis of axisymmetric shells by finite element method with convected coordinates
[CONF-770807-34] N78-21505
SHIELDING
Study of the ablative effects on tektites: Atmosphere entry of a swarm of tektites --- shielding by hypersonic wake
[NASA-CR-156733] N78-22007
SHIPS
Satellite surveillance avoidance optimization aid --- for naval operations
[AD-A049561] N78-21195
Wave measurement and implementation aboard ship
[PB-276070/0] N78-21741
SHOCK RESISTANCE
Some numerical results on asymptotic failure distributions
[AD-A049775] N78-21879
SHOCK TUBES
Emission spectrum of the NU3 band of SF6 at 1780K
[AD-A049865] N78-21242
SHOCK WAVES
An investigation of the influence of shock-wave profile on the mechanical and thermal responses of polycrystalline iron
[AD-A049764] N78-21278
Effects of impurities on shock wave stability and structure in ionizing monatomic gases
[UTIAS-TN-212] N78-21405
A three-dimensional study of fin-induced shock wave turbulent boundary layer interaction
[AD-A049772] N78-21420
SHORELINES
Coastal wetlands along Lake Ontario and the St. Lawrence in Jefferson County, New York
[PB-276031/2] N78-21744
SHORT CIRCUITS
Controlled impedance short circuit limiter
[EPRI-EL-537] N78-21392
SHORT HAUL AIRCRAFT
Effect of high lift flap systems on the conceptual design of a 1985 short-haul commercial STOL tilt rotor transport
[NASA-TM-78474] N78-21094
SHORT TAKEOFF AIRCRAFT
Effect of high lift flap systems on the conceptual design of a 1985 short-haul commercial STOL tilt rotor transport
[NASA-TM-78474] N78-21094
SHOT NOISE
Approximations for the amplitude distribution and density of shot processes
N78-21370
SHROUDS
Boundary layer analysis of a Centaur standard shroud
[NASA-TM-78843] N78-21404
SIGNAL DETECTION
Approximations for the amplitude distribution and density of shot processes
N78-21370
SIGNAL PROCESSING
Interpretation of single-channel seismic reflection records
[AD-A047511] N78-21696
SIGNAL TO NOISE RATIOS
Signal-to-noise ratio estimation in digital computer simulation of lowpass and bandpass systems with applications to analog and digital communications
N78-21329
Long-range holography field experiments
[AD-A050122] N78-21433
SILICATES
Laboratory simulation of infrared astrophysical features --- silicate mixtures with emission spectra matching those of comets
N78-21998
SILICON
Structure of deformed silicon and implications for low cost solar cells
[NASA-CR-156166] N78-21600
SILICON ALLOYS
Alloy corrosion-fundamental studies of dissolution and passivity of alloys and compounds
[AD-A049848] N78-21273
SILICON CARBIDES
Friction and metal transfer for single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1191] N78-21294
Wear of single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1198] N78-21295
SILICON COMPOUNDS
Development of SiAlON materials
[NASA-CR-135290] N78-21289
Novel silicon crystals and method for their preparation
[NASA-TM-75195] N78-21957
SILICON NITRIDES
Erosion of brittle materials by solid particle impact
[AD-A050252] N78-21296
SILVER COMPOUNDS
Application and theoretical studies of silver and mercuric sulfide-based ion selective electrodes
N78-21369
SIMULATION
Pretest information for a test to validate plume simulation procedures [FA-17]
[NASA-CR-150638] N78-21210
Aircraft cargo compartment fire test simulation program
[NASA-CR-151951] N78-21223
Combustion properties of high density fuels --- liquid rocket propellant combustion simulation using pneumatic equipment
[AD-A050051] N78-21310
Laboratory simulation of infrared astrophysical features --- silicate mixtures with emission spectra matching those of comets
N78-21998
SIMULTANEOUS EQUATIONS
Direct numerical solution of large sets of simultaneous equations
[AD-A050058] N78-21850

SINGLE CRYSTALS
Friction and metal transfer for single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1191] N78-21294
Wear of single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1198] N78-21295
Novel silicon crystals and method for their preparation
[NASA-TM-75195] N78-21957

SINGLE-PHASE FLOW
Natural circulation calculation: Single-phase and two-phase flow in pipes
[DOE-TR-15] N78-21425

SINTERING
Microstructure evolution during sintering of beta - alumina compositions
N78-21258
Development of SiAlON materials
[NASA-CR-135290] N78-21289

SITES
Use of remote sensing in facility siting
N78-21555
Progress toward a circulation atlas for application to coastal water siting problems
[VIMS-CONTRIB-823] N78-21560

SIZE [DIMENSIONS]
Characteristic size spectra of cumulus fields observed from satellites
[AD-A049936] N78-21724

SLIDING FRICTION
Wear of single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1198] N78-21295

SLOTS
Flow of viscous gas in the region of a slot with strong suction
[NASA-TM-75241] N78-21411

SMOKE
Evaluation of Federal Aviation Administration ion engine exhaust sampling rake
[NASA-CR-135213] N78-21111

SMOOTHING
Inertial smoothing and extrapolation of ILS beams: Application to the Airbus A 300 B
N78-21074

SNOW
Pavement heating: Executive summary
[PB-276504/8] N78-21327
Investigation of the application of HCMM thermal data to snow hydrology
[E78-10116] N78-21521

SNOW COVER
Metric remote sensing experiments in preparation for Spacelab flights --- alpine geomorphology and ice and/or snow cover
[NASA-TM-75093] N78-21571
Snow parameters from Nimbus-6 electrically scanned microwave radiometer --- [ESMR-6]
[NASA-CR-156725] N78-21572
Microwave emission from polar firn
[NASA-TP-1212] N78-21690

SOCIAL FACTORS
Energy conservation in the home: An energy education/conservation curriculum guide for home economics teachers
[EDM-1028] N78-21607

SOIL MECHANICS
Earthflow
N78-21684

SOIL MOISTURE
A model of the 0.4-GHz scatterometer --- used for agriculture soil moisture program
[NASA-CR-151693] N78-21574

SOILS
HCMM energy budget data as a model input for assessing regions of high potential groundwater pollution
[E78-10111] N78-21516
LANCHAD: Remote sensing of the N'Djamena area and the Logone-Chari confluent
[NASA-TM-75087] N78-21570

SOLAR ACTIVITY
Survey and comparison of solar activity and energetic particle emission in 1970
[AD-A048479] N78-22013
Solar-geophysical data number 398, October 1977. Part 1, prompt reports: Data for September - August 1977
[PB-275858/9] N78-22014
Solar-geophysical data number 398, October 1977. Part 2, comprehensive reports: Data for April - Mar. 1977 and miscellanea
[PB-275859/7] N78-22015

SOLAR ARRAYS
Construction in space: A proposed experiment in support of the space solar power concept and other large space systems
[NASA-TM-79435] N78-21179
Charging of flexible solar array substrates in kilovolt electron beams
[NASA-TM-73865] N78-21199

SOLAR ATMOSPHERE
Non-radial p mode oscillations as a seismic probe of solar structure
N78-22008

SOLAR CELLS
Results of the 1974 through 1977 NASA/JPL balloon flight solar cell calibration program
[NASA-CR-156180] N78-21598
Structure of deformed silicon and implications for low cost solar cells
[NASA-CR-156166] N78-21600
Characterization of solar cells for space applications. Volume 1: Electrical characteristics of OCLI violet solar cells as a function of intensity and temperature
[NASA-CR-156162] N78-21601
Space solar power. Description of concept, results of preliminary studies, requirements for evaluation
[NASA-TM-79436] N78-21611
Improved semiconductors for photovoltaic solar cells
[DSE/2460-2] N78-21646

SOLAR COLLECTORS
Owens-Illinois liquid solar collector materials assessment
[NASA-TM-78163] N78-21597
Subsystem design package for Solar II collector
[NASA-CR-150611] N78-21602
Development of prototype air/liquid solar collector subsystem
[NASA-CR-150627] N78-21604
Use of the Marshall Space Flight Center solar simulator in collector performance evaluation
[NASA-TM-78165] N78-21605
Studies on methods of reducing heat losses from flat plate solar collectors, phase 2
[COO/2597-3] N78-21624
Solar space heating systems using annual heat storage
[COO/2939-1] N78-21645
Analysis of data and results for the roundrobin flat-plate collector test program
[PB-275576/7] N78-21655

SOLAR COOLING
System design package for solar heating and cooling site data acquisition subsystem
[NASA-CR-150606] N78-21593

SOLAR CORONA
The structure of the solar transition region and inner corona
N78-22011

SOLAR CYCLES
A division of the aa indices into six classes based on the Ap' index, 1868-1976
[PB-276388/6] N78-21708

SOLAR ENERGY
Modeling of Rankine cycle/vapor compression cycle cooling systems for solar energy applications
N78-21587
Combined heat and power: A discussion of Energy Paper 20
[ERG-018] N78-21608
Solar energy for the Naval Shore Establishment
[AD-A050026] N78-21616
Energy conservation via solar energy application to multi-family and commercial structures. Volume 2, part 2: Solar energy atlas for New York state
[PB-276130/2] N78-21618
Distributed technologies in California's energy future, volume 1
[LBL-6831-VOL-1] N78-21623
Development of a practical photochemical energy storage system
[SRO-893-9] N78-21628
Development of a practical photochemical energy storage system
[SRO-893-10] N78-21629
Energy conservation via solar energy applications to multi-family and commercial structures. Volume 3: An energy, engineering and economic analysis of heating and cooling systems for multi-family structures
[PB-276131/0] N78-21657

SOLAR ENERGY CONVERSION
Space solar power. Description of concept, results of preliminary studies, requirements for evaluation
[NASA-TM-79436] N78-21611

SOLAR FLARES
A study of the propagation and intrinsic characteristics of flare-associated particle events
N78-22010

SOLAR GENERATORS
Small Power Systems Solar Electric Workshop Proceedings. Volume 1: Executive report. Volume 2: Invited papers
[NASA-CR-156165] N78-21599
Space solar power. Description of concept, results of preliminary studies, requirements for evaluation
[NASA-TM-79436] N78-21611

SOLAR HEATING
System design package for IBM system one: solar heating and domestic hot water
[NASA-CR-150614] N78-21589
Prototype solar heated hot water systems and double-walled heat exchangers: A collection of quarterly reports
[NASA-CR-150591] N78-21591
Solar heat transport fluid
[NASA-CR-150612] N78-21592
System design package for solar heating and cooling site data acquisition subsystem
[NASA-CR-150606] N78-21593
Central Data Processing System [CDPS] user's manual: Solar heating and cooling program
[NASA-CR-150580] N78-21595
Subsystem design package for Solar II collector
[NASA-CR-150611] N78-21602
Preliminary design package for solar hot water system
[NASA-CR-150617] N78-21603
Design method for heat loss calculation for in-ground heat storage tanks
[COO-2923-3] N78-21625
Development of a practical photochemical energy storage system
[SRO-893-6] N78-21626
Development of a practical photochemical energy storage system
[SRO-893-8] N78-21627

SOLAR LIMB
The structure of the solar transition region and inner corona
N78-22011

SOLAR RADIO EMISSION
Experimental solar radio spectrum analyzer [50-100 MHz]
[NASA-CR-156079] N78-22012
Solar-geophysical data number 398, October 1977. Part 1, prompt reports: Data for September - August 1977
[PB-275858/9] N78-22014
Solar-geophysical data number 398, October 1977. Part 2, comprehensive reports: Data for April - Mar. 1977 and miscellanea
[PB-275859/7] N78-22015

SOLAR SIMULATORS
Use of the Marshall Space Flight Center solar simulator in collector performance evaluation
[NASA-TM-78165] N78-21605

SOLAR SPECTRA
Analysis of EUV solar line profiles of Si-2 and Si-3
N78-22009

SOLAR WIND
Solar-geophysical data number 398, October 1977. Part 1, prompt reports: Data for September - August 1977
[PB-275858/9] N78-22014

SOLAR X-RAYS
Solar-geophysical data number 398, October 1977. Part 1, prompt reports: Data for September - August 1977
[PB-275858/9] N78-22014
Solar-geophysical data number 398, October 1977. Part 2, comprehensive reports: Data for April - Mar. 1977 and miscellanea
[PB-275859/7] N78-22015
Hard X-ray imaging facility for space shuttle: A scientific and conceptual engineering study
[NASA-CR-156736] N78-22016

SOLID PROPELLANT ROCKET ENGINES
Initiation mechanisms of solid rocket propellant detonation
[AD-A049531] N78-21305
Shear strength of fillet welds in aluminum alloy 2219 --- for use on the solid rocket motor and external tank
[NASA-TM-78168] N78-21495

SOLID PROPELLANTS
Inorganic halogenoxidizer research
[AD-A050133] N78-21238
A reacting turbulent boundary layer approach to solid propellant erosive burning
[AD-A049537] N78-21307

SOLID ROCKET PROPELLANTS
Modeling of convective mode combustion through granulated propellant to predict transition to detonation
[AD-A049499] N78-21302
Audible and ultrasonic acoustic emissions from composite solid propellants
[AD-A049517] N78-21304
A reacting turbulent boundary layer approach to solid propellant erosive burning
[AD-A049537] N78-21307

SOLID SOLUTIONS
Pressure dependence of the elastic moduli of body-centered-cubic transition metals
N78-21943

SOLID STATE
On the question of the fracture mechanism for solid polymers
N78-21290

SOLID STATE DEVICES
Development and application of data processing and pattern recognition methods
[AD-A049846] N78-21982

SOLID SURFACES
Long range interactions between atoms absorbed on surfaces
N78-21944
Energy transfer at solid surfaces --- thermal emission, thermal conduction and gas-surface energy exchange
N78-21956

SOLID WASTES
Net energy from municipal solid waste
[ORAU/IEA[M]-77-5] N78-21653
SOLIDIFICATION
Gravity segregation of primary particles during solidification of binary eutectiferous alloys
N78-21261
SOLIDS
Theoretical studies of optical phenomena in solids
N78-21946
High-pressure studies of soft mode transitions in solids
[SAND-77-1188C] N78-21968
SONDES
An evaluation of electrochemical concentration Celi [ECC] sonde measurements of atmospheric ozone
[NASA-CR-2973] N78-21429
SOUND TRANSMISSION
Multichannel still-picture transmission system: TDM transmission of delta-M sounds with still-picture in television channel
[NHK-LABS-NOTE-214] N78-21330
Experimental and theoretical sound transmission --- reduction of interior noise in aircraft
[NASA-CR-156170] N78-21889
Sound transmission from a tapered fluid layer into a fast bottom
[AD-A050021] N78-21892
SOUND WAVES
Monolithic surface wave transversal filter
[AD-A049938] N78-21385
A study of the interaction of X-rays and acoustic waves in solids
N78-21888
SOUTH AMERICA
Study of vertical movement and associative precipitation by extratropical perturbations in South America
[E78-10107] N78-21513
SPACE EXPLORATION
Space orbits of collaboration --- international cooperation and the U.S.S.R. space program
[NASA-TM-75096] N78-21176
SPACE INDUSTRIALIZATION
Utilization of lunar materials and expertise for large scale operations in space: Abstracts --- lunar bases and space industrialization
[NASA-CR-156167] N78-21180
SPACE MANUFACTURING
Division 2: Materials in space engineering. Chapter 3: Influence of the space medium on materials
N78-21178
SPACE PERCEPTION
How big the moon, how fat the eye?
[AD-A050211] N78-21756
SPACE PROCESSING
Utilization of lunar materials and expertise for large scale operations in space: Abstracts --- lunar bases and space industrialization
[NASA-CR-156167] N78-21180
Applications notice --- application of space techniques to earth resources, environment management, and space processing
[AN-OSTA-78-A] N78-21991
SPACE PROCESSING APPLICATIONS ROCKET
Space Processing Applications Rocket project SPAR III
[NASA-TM-78137] N78-21189
SPACE PROGRAMS
A turning point in space: Has the time arrived for a national review of our space policy
[AD-A049926] N78-21182
SPACE SHUTTLE ORBITERS
Space shuttle L-tube radiator testing
[NASA-CR-151695] N78-21196
Shuttle orbiter - IUS/DSP satellite interface contamination study
[NASA-CR-151682] N78-21197
Orbiter S-band FM system console test procedure
[NASA-CR-151694] N78-21338
SPACE SHUTTLES
Analysis and test for space shuttle propellant dynamics: 1/60th scale model test results
[NASA-CR-151681] N78-21301
Metric remote sensing experiments in preparation for Spacelab flights --- alpine geomorphology and ice and/or snow cover
[NASA-TM-75093] N78-21571
Hard X-ray imaging facility for space shuttle: A scientific and conceptual engineering study
[NASA-CR-156736] N78-22016
SPACE SURVEILLANCE (SPACEBORNE)
Satellite surveillance avoidance optimization aid --- for naval operations
[AD-A049561] N78-21195
SPACE TRANSPORTATION
Shuttle orbiter - IUS/DSP satellite interface contamination study
[NASA-CR-151682] N78-21197
SPACE TRANSPORTATION SYSTEM
Construction in space: A proposed experiment in support of the space solar power concept and other large space systems
[NASA-TM-79435] N78-21179
Engineering study for pallet adapting the Apollo laser altimeter and photographic camera system for the Lidar Test Experiment on orbital flight tests 2 and 4
[NASA-CR-152615] N78-21525
SPACEBORNE EXPERIMENTS
The Plasma Interaction Experiment [PIX] description and test program --- electrometers
[NASA-TM-78863] N78-21188
SPACEBORNE PHOTOGRAPHY
Apollo over the moon: A view from orbit
[NASA-SP-362] N78-21174
Engineering study for pallet adapting the Apollo laser altimeter and photographic camera system for the Lidar Test Experiment on orbital flight tests 2 and 4
[NASA-CR-152615] N78-21525
SPACECRAFT
Investigation of high voltage spacecraft system interactions with plasma environments
[NASA-TM-78831] N78-21373
SPACECRAFT CHARGING
NASA charging analyzer program: A computer tool that can evaluate electrostatic contamination
[NASA-TM-73889] N78-21372
SPACECRAFT COMMUNICATION
Large active retrodirective arrays for space applications
[NASA-CR-156163] N78-21333
SPACECRAFT CONTAMINATION
Theoretical contamination of cryogenic satellite telescopes
[NASA-TP-1177] N78-21193
Shuttle orbiter - IUS/DSP satellite interface contamination study
[NASA-CR-151682] N78-21197
SPACECRAFT CONTROL
The N-BOD2 user's and programmer's manual
[NASA-TP-1145] N78-21200
SPACECRAFT DESIGN
An interstellar precursor mission
[NASA-CR-156152] N78-21173
Severe storms observing satellite [STORMSAT]
[NASA-CR-156735] N78-21720
SPACECRAFT ENVIRONMENTS
Tsiolkovsky's Ideas on Cosmonautic Problems
[NASA-TT-F-16118] N78-21177
SPACECRAFT INSTRUMENTS
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10105] N78-21511
LANDSAT-C flight activation plan
[E78-10106] N78-21512
SPACECRAFT MOTION
Simplified model of statistically stationary spacecraft rotation and associated induced gravity environments
[NASA-TM-78164] N78-21198
SPACECRAFT POWER SUPPLIES
Space electric power design study --- laser energy conversion
[NASA-CR-152031] N78-21590
SPACECRAFT PROPULSION
An assessment of an F2 or N2O4 atmospheric injection from an aborted space shuttle mission
[NASA-CR-156164] N78-21664
SPACECRAFT RADIATORS
Space shuttle L-tube radiator testing
[NASA-CR-151695] N78-21196
SPACECRAFT REENTRY
Technology for return of planetary samples, 1977
[NASA-CR-156169] N78-21181
SPACECRAFT STRUCTURES
Effect of attitude control thruster induced structural vibrations on sensed accelerations of a space vehicle
[LA-6965-MS] N78-21201
SPACELAB
Metric remote sensing experiments in preparation for Spacelab flights --- alpine geomorphology and ice and/or snow cover
[NASA-TM-75093] N78-21571
SPACELAB PAYLOADS
Synthesis and analysis of precise spaceborne laser ranging systems, volume 2 --- Spacelab payload
[NASA-CR-156728] N78-21443
SPARK IGNITION
Photographic characterization of spark-ignition engine fuel injectors
[NASA-TM-78830] N78-21110
Lightweight, low compression aircraft diesel engine --- converting a spark ignition engine to the diesel cycle
[NASA-CR-135300] N78-21471
SPECIFICATIONS
Acceptance sampling of structural paints
[PB-275757/3] N78-21300
SEMANOL [76] reference manual, volume 2
[AD-A049473] N78-21794
SEMANOL [76] specification of Jovial [J3], volume 3
[AD-A049474] N78-21795
SPECKLE PATTERNS
Speckle noise in satellite based lidar systems
[NASA-CR-156723] N78-21444
SPECTRAL SIGNATURES
Inventory of forest resources [including water] by multi-level sampling --- nine northern Virginia coastal plain counties
[E78-10118] N78-21522
SPECTROHELIOGRAPHS
The structure of the solar transition region and inner corona
N78-22011
SPECTROMETERS
Tunable diode laser heterodyne spectrometer for balloon-borne solar radiometry in the stratosphere
[SAND-77-0601] N78-21463
SPECTROPHOTOMETRY
Spectrophotometric investigations of white dwarf stars
N78-21994
SPECTROSCOPIC ANALYSIS
High-resolution spectroscopy using tunable diode lasers: Techniques and applications
[LA-UR-77-2222] N78-21917
SPECTRUM ANALYSIS
Analysis of Angular Dependent Auger Spectroscopy [ADAS] based on a quasiatomic model
[CONF-770908-6] N78-21966
Experimental solar radio spectrum analyzer [50-100 MHz]
[NASA-CR-156079] N78-22012
SPEECH RECOGNITION
Performance measurements of the CVSD speech coding algorithm
[AD-A050163] N78-21362
SPIN DYNAMICS
Relativistic neutron gas interacting through a spin 2 field and its astrophysical applications
N78-22004
SPIN EXCHANGE
The exchange constant of germanium substituted yttrium iron garnet films
N78-21251
SPIN-LATTICE RELAXATION
Superconductivity, spin-glass properties, and ferromagnetism in amorphous La-Gd-Au alloys
N78-21951
SPINAL CORD
Radiographic and biomechanical studies of the human spine
[AD-A049984] N78-21758
SPLASHING
A note on multicyclic control by swashplate oscillation
[NASA-TM-78475] N78-21159
SPONTANEOUS EMISSION
Cooperative spontaneous emission and nonlinear stimulated emission
N78-21439
STABILITY
Effects of impurities on shock wave stability and structure in ionizing monatomic gases
[UTIAS-TN-212] N78-21405
The stability of second order quadratic differential equations
[AD-A049771] N78-21865
Theory and simulation of the stability of Bernstein-Greene-Kruskal waves --- vlasov equations and laplace transformation
N78-21918
Drift waves in inhomogeneous plasmas with shear and temperature gradients
N78-21919
Tokamak impurity instabilities
[ERDA-TR-314] N78-21934
Effect of flux flow on self-field instability
[ORNL/TM-5986] N78-21967
STAINLESS STEELS
Fabrication of stainless steel clad tubing --- gas pressure bonding
[NASA-CP-135347] N78-21265
Influence of fretting on flexural fatigue of 304 stainless steel and mild steel
[NASA-TP-1193] N78-21269
Basic creep-rupture testing at 1100 deg F [593 deg C] of type 304 stainless steel for uniaxially loaded specimens with stress and strain gradients
[WARD-HT-3045-26] N78-21284
STANDARDIZATION
Computer family architecture selection committee. Volume 8: CFA final selection
[AD-A049485] N78-21777
Computer family architecture selection committee. Volume 9: A consideration of issues in the selection of a computer family architecture
[AD-A049486] N78-21778
Computer family architecture selection committee. Volume 2: Selection of candidate architectures and initial screening
[AD-A049457] N78-21779
Computer family architecture selection committee. Volume 1: Introduction
[AD-A049468] N78-21782
STANDARDS
Code of practice for methods for hardness testing of metallic materials
[SABS-055-1977-REV-1] N78-21264

Code of practice for welding. Part 5: Welders' competence tests for manual oxy-acetylene, manual metal-arc, manual gas-shielded tungsten-arc, and manual gas-shielded metal-arc welding of mild steel [carbon steel] and medium high tensile steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-5-1976-REV-1] N78-21467
California residential energy standards: Problems and recommendations relating to implementation, enforcement, design
[SAN/1178-1] N78-21640
Improvements to SEMANOL, volume 1
[AD-A049472] N78-21793
Software engineering. Volume 1: Its development and standards
[AD-A049869] N78-21813

STATIC AERODYNAMIC CHARACTERISTICS
Effect of turbulent jet mixing on the static lift performance of a power augmented ram wing
[AD-A049620] N78-21060

STATIC LOADS
A study of the effect of carbon upon the elevated temperature mechanical, fracture and static load crack extension behavior of austenitic stainless steel N78-21255

STATICS
Static and dynamic textures in superfluid He-3 — Landau-Ginzburg equations N78-21954

STATISTICAL ANALYSIS
Forecasting thunderstorms over a 2-to-5-h period by statistical methods
[AD-A050005] N78-21723
Selected topics in statistical meteorology
[AD-A050035] N78-21725
A note on the use of second-order gray level statistics for threshold selection
[AD-A049454] N78-21820
Statistical analysis of a forecasting model using one-dimensional nonlinear transformations N78-21843
Asymptotic distribution of symmetric statistics
[AD-A049395] N78-21862
Nonparametric procedures for process control N78-21870
Convergence of weighted sums of random elements and statistical applications N78-21872
Interactive statistical software
[AD-A049707] N78-21874
A study of renewal processes with IMRL and DFR interarrival times
[AD-A049989] N78-21875
On the convolution of logistic random variables
[AD-A049996] N78-21876
Simulation studies on some nearest neighbor rules for statistical classification
[AD-A049548] N78-21877
Approximate solutions for certain optimal stopping problems
[AD-A049556] N78-21878

STATISTICAL DISTRIBUTIONS
Further progress on robust/resistant widthers
[AD-A049701] N78-21852
Simulation studies on some nearest neighbor rules for statistical classification
[AD-A049548] N78-21877

STATOR BLADES
Use of leaning vanes in a two stage fan
[NASA-CR-152134] N78-21115
The influence of jets of cooling air exhausted from the trailing edges of a supercritical turbine cascade on the aerodynamic data N78-21148

STEADY STATE
The torsional analysis of steady state and transient wave propagation in elastic cylinders N78-21487

STEAM
Anomalous infrared emission from condensing and cooling steam clouds
[AD-A050083] N78-21914

STELLAR STRUCTURE
Non-radial p mode oscillations as a seismic probe of solar structure N78-22008
The structure of the solar transition region and inner corona N78-22011

STIMULATED EMISSION
Cooperative spontaneous emission and nonlinear stimulated emission N78-21439

STIMULATED EMISSION DEVICES
Experimental determination of nonlinear constants for self-focusing and stimulated Raman emission N78-21438

STOCHASTIC PROCESSES
A satellite control problem
[AD-A049510] N78-21194
Simplified model of statistically stationary spacecraft rotation and associated induced gravity environments
[NASA-TM-78164] N78-21198
A synthesis technique for the resolution of large scale fluid logic networks N78-21400
On the stochastic modeling of daily streamflows N78-21508
Stochastic filtering and control
[AD-A049992] N78-21829
Role of statistical linearization in the solution of nonlinear stochastic equations
[UCRL-80094] N78-21867
Stationary stochastic and discrete Markov process. Part 1: The range of a strictly stationary stochastic process. Part 2: Some additional results concerning limits of a discrete Markov process N78-21868
Nonparametric procedures for process control N78-21870

STOCKPILING
Helium: A public policy problem
[PB-276040/3] N78-21585

STOPPING
Approximate solutions for certain optimal stopping problems
[AD-A049995] N78-21856
Approximate solutions for certain optimal stopping problems
[AD-A049556] N78-21878

STORAGE
Optimal control of a storage system N78-21772

STORAGE BATTERIES
Engineering evaluation tests of 3-4 ampere-hour sealed lead-acid batteries Elpower, ESB, Eagle-Pitcher, Globe Union and Gates
[AD-A049445] N78-21614

STORAGE RINGS [PARTICLE ACCELERATORS]
Generation and behavior of long-lived field reversing electron rings in strong toroidal fields N78-21920

STORMS
National Severe Storms Laboratory: Program and history
[PB-276402/5] N78-21730

STORMS [METEOROLOGY]
Severe storms observing satellite [STORMSAT]
[NASA-CR-156735] N78-21720
A statistical study of synoptic storm activity over the North Pacific in 1975
[AD-A050052] N78-21729

STORMSAT SATELLITE
Severe storms observing satellite [STORMSAT]
[NASA-CR-156735] N78-21720

STRAIN GAGES
Small inner spherical radius sweep gage
[MHSMP-77-5G] N78-21434

STRAIN RATE
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and in 100
[NASA-TM-78828] N78-21267

STRAPDOWN INERTIAL GUIDANCE
Accuracy limitation on strapdown calculations in a coning environment due to a given approximation to the body rate vector
[SAND-77-0726] N78-21069
Future applications of low cost strapdown laser inertial navigation systems N78-21072
New techniques for low cost strapdown inertial systems N78-21073

STRATIFICATION
Temperature fine-structure in the Southern Ocean N78-21735

STRATOSPHERE
Calculated rate constants for the reaction ClO + O yields Cl + O2 between 220 and 1000 deg K — molecular trajectories and stratospheric ozone
[NASA-TM-78483] N78-21215
The relation of oxidant levels to precursor emissions and meteorological features. Volume 2: Review of available research results and monitoring data, as of November 1975
[PB-275326/7] N78-21672
The relation of oxidant levels to precursor emissions and meteorological features. Volume 3: Appendices [analytical methods and supplementary data]
[PB-275327/5] N78-21673
Software development: Stratosphere modeling
[NASA-CR-156722] N78-21692

STREAMS
On the stochastic modeling of daily streamflows N78-21508

STRESS [PHYSIOLOGY]
Cosmonaut work capacity in flight N78-21762

STRESS [PSYCHOLOGY]
Cosmonaut work capacity in flight N78-21762

STRESS ANALYSIS
In situ ply strength: An initial assessment — using laminate fracture data and a least squares method
[NASA-TM-73771] N78-21220

STRESS CONCENTRATION
Basic creep-rupture testing at 1100 deg F [593 deg C] of type 304 stainless steel for uniaxially loaded specimens with stress and strain gradients
[WARD-HT-3045-26] N78-21284

STRESS CORROSION
A fracture mechanics analysis of the kinetics of stress-corrosion crack growth in a high-strength 12Ni-5Cr-3Mo maraging steel N78-21256

STRESS CORROSION CRACKING
High temperature corrosion of Ni-base for turbine blades alloys in sulphate-chloride containing environments N78-21140

STRESS CYCLES
The stress clock function in viscoelasticity N78-21486

STRESS MEASUREMENT
Report on aircraft fatigue studies — in-flight monitoring and stress measurements
[AD-A049876] N78-21102

STRESS RELAXATION
Stress relaxation in physically nonlinear polymer materials under combined tension with torsion N78-21293
Development of a ceramic tube heat exchanger with relaxing joint
[FE-2556-06] N78-21423

STRESS-STRAIN DIAGRAMS
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 2: Crack opening displacement and stress-strain data
[NASA-CR-135370] N78-21494

STRESS-STRAIN-TIME RELATIONS
The stress clock function in viscoelasticity N78-21486

STRUCTURAL ANALYSIS
Analytical and numerical investigation of structural response of compliant wall materials
[NASA-CR-156151] N78-21491

STRUCTURAL DESIGN CRITERIA
Trends of future turbine life prediction: Time phase automated analysis and test verification N78-21143
Definition of requirements for geothermal power conversion system studies
[UCRL-13751] N78-21650

STRUCTURAL MEMBERS
Dynamic response of linear damped continuous structural members N78-21485

STRUCTURAL RELIABILITY
A-4F Blue Angel flight usage data, 1976
[AD-A050164] N78-21100

STRUCTURAL STABILITY
Structural and magnetic studies of selected rare earth intermetallics N78-21949

STRUCTURAL VIBRATION
Effect of attitude control thruster induced structural vibrations on sensed accelerations of a space vehicle
[LA-6965-MS] N78-21201
A perturbation method for predicting amplitudes of nonlinear wheel shimmy N78-21464

SUBROUTINES
PDP 11 image processing software
[AD-A049586] N78-21799
PLOT user's manual
[ORNL/CSD/TM-41] N78-21816

SUBSONIC SPEED
Heat transfer to a PVD rotor blade at high subsonic passage throat Mach numbers N78-21150

SUBSONIC WIND TUNNELS
Unsteady two dimensional airloads acting on oscillating thin airfoils in subsonic ventilated wind tunnels
[NASA-CR-2967] N78-21059

SUBSTRATES
Thin films of gallium arsenide on low-cost substrates
[SAN/1202-77/2] N78-21965

SUCTION
Flow of viscous gas in the region of a slot with strong suction
[NASA-TM-75241] N78-21411

SULFATES
High temperature corrosion of Ni-base for turbine blades alloys in sulphate-chloride containing environments N78-21140
Comparison of wet chemical and instrumental methods for measuring airborne sulfate
[PB-276620/2] N78-21248

SULFIDES
Application and theoretical studies of silver and mercuric sulfide-based ion selective electrodes N78-21369

SULFUR
Study of the effects of gaseous environments on sulfidation attack of superalloys
[NASA-CR-135348] N78-21268

SULFUR COMPOUNDS
Thermochemistry and kinetics of sulfur containing molecules and radicals
[PB-275721/9] N78-21247
SULFUR OXIDES
Work on power-plant [air] plumes involving remote sensing of SO2
N78-21548
SUPERCONDUCTIVITY
Superconductivity, spin-glass properties, and ferromagnetism in amorphous La-Gd-Au alloys
N78-21951
Quasiparticle interference effects in the tunneling characteristics of thick superconducting films of zinc
N78-21952
The superconductivity of certain ternary molybdenum compounds
[NASA-TM-75250] N78-21958
SUPERCONDUCTORS
Metastable metallic superconductors with high transition temperatures and composite superconductors
[AD-A050055] N78-21282
Nonequilibrium properties of variable-thickness superconducting micro-bridges
[AD-A049779] N78-21381
Cryogenic-coolant He-4-superconductor interaction
[NASA-CR-2963] N78-21406
Properties of new superconducting materials --- niobium and germanium compounds
[AD-A050296] N78-21959
Effect of flux flow on self-field instability
[ORNL/TM-5986] N78-21967
SUPERFLUIDITY
Static and dynamic textures in superfluid He-3 --- Landau-Ginzburg equations
N78-21954
SUPERHIGH FREQUENCIES
Orbiter S-band FM system console test procedure
[NASA-CR-151694] N78-21338
SUPERPLASTICITY
Application of superplastic steels --- thermomechanical forging of carbon steels
[AD-A049469] N78-21270
SUPERSONIC COMBUSTION
Rectangular capture area to circular combustor scramjet engine
[NASA-TM-78657] N78-21107
SUPERSONIC FLIGHT
Evaluation of windshield materials subjected to simulated supersonic flight
[AD-A049981] N78-21101
SUPERSONIC TRANSPORTS
Low-speed aerodynamic characteristics from wind-tunnel tests of a large-scale advanced arrow-wing supersonic-cruise transport concept
[NASA-CR-145280] N78-21053
SUPERSONIC WIND TUNNELS
Wind tunnel performance tests of coannular plug nozzles --- in the Langley 8 x 6 ft. supersonic wind tunnel
[NASA-CR-2990] N78-21044
SUPPORTS
Adapting a turbine engine test stand for high temperature research
N78-21124
SURFACE ACOUSTIC WAVE DEVICES
Surface acoustic wave stabilized oscillators
[NASA-CR-156724] N78-21374
SURFACE COOLING
Protection of cooled blades of complex internal structure
N78-21141
Finite element analysis of some problems arising in cooled turbine blades
N78-21144
SURFACE CRACKS
Relationships between structure and micromechanics of solvent crazes in glassy polymers
N78-21288
SURFACE DEFECTS
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 1: Program summary and data analysis
[NASA-CR-135369] N78-21493
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 2: Crack opening displacement and stress-strain data
[NASA-CR-135370] N78-21494
SURFACE ENERGY
Long range interactions between atoms absorbed on surfaces
N78-21944
Energy transfer at solid surfaces --- thermal emission, thermal conduction and gas-surface energy exchange
N78-21956
Binding energy and effectiveness mass of charged particles trapped on surfaces
[AD-A049945] N78-21964
SURFACE FINISHING
Charging of flexible solar array substrates in kilovolt electron beams
[NASA-TM-73865] N78-21199
SURFACE LAYERS
Shielding by a surface layer of electrons, 1. Weak electromagnetic fields near a black hole, 2.
N78-22003
SURFACE PROPERTIES
Optical surface studies of titanium and titanium-aluminum alloys with application to the mechanism of passivity and non-destructive testing
[AD-A050212] N78-21276
Surface chemistry of fluoropolymer barrier films: Relation of solution variables to film properties
[AD-A050003] N78-21298
Study of surface fatigue wear by exoelectron emission
[AD-A049927] N78-21476
Characterization of surfaces by low energy helium scattering
N78-21941
SURFACE REACTIONS
Evaluation of two computer programs for modeling electromagnetic interactions with surfaces
[UCRL-52321] N78-21368
Theoretical studies of optical phenomena in solids
N78-21946
Prospects for studying gas chemisorption kinetics using current fluctuations
N78-21953
Chemisorption and reaction mechanisms on iron and iridium surfaces
N78-21955
SURFACE ROUGHNESS
Investigation of the surface roughness of evaporated copper films by optical scattering
N78-21252
SURFACE TEMPERATURE
Temperature profile of graphite surface burning in a stream of oxygen
[NASA-TM-75271] N78-21232
The vaporization behavior of a fuel drop on a hot surface --- aircraft fuel drop evaporation
[AD-A049471] N78-21303
HCMM satellite to take earth's temperature
[NASA-NEWS-RELEASE-78-60] N78-21507
Quantitative determination of surface temperatures using an infrared camera
[CONF-770868-2] N78-21916
SURFACE WATER
Inventory of forest resources [including water] by multi-level sampling --- nine northern Virginia coastal plain counties
[E78-10118] N78-21522
Water resources data for Washington, water year 1976. Volume 1: Western Washington
[PB-275886/0] N78-21581
Water resources data for Washington, water year 1976. Volume 2: Eastern Washington
[PB-275887/8] N78-21582
Water resources data for California, water year 1976. Volume 3: Southern central valley basins, and the great basin from Walker River to Trucke River
[PB-276354/8] N78-21586
SURFACE WAVES
Monolithic surface wave transversal filter
[AD-A049938] N78-21385
Seismic studies of surface and body waves for improved yield determination
[AD-A049958] N78-21705
SURVEILLANCE
Distributed sensor networks
[AD-A050160] N78-21576
SURVEYS
Colder - darker: The energy crisis and low-income Americans; an analysis of impact and options
[PB-275656/7] N78-21656
SWEEP EFFECT
Small inner spherical radius sweep gage
[MHSMP-77-5G] N78-21434
SWEPT WINGS
Subsonic longitudinal and lateral-directional static aerodynamic characteristics for a close-coupled wing-canard model in both swept back and swept forward configurations
[NASA-TM-74092] N78-21049
A vectorization of the Jameson-Caughey NYU transonic swept-wing computer program FLO-22-V1 for the STAR-100 computer
[NASA-TM-78665] N78-21050
Effect of leading-edge contour and vertical-tail configuration on the low-speed stability characteristics of a supersonic transport model having a highly-swept arrow wing
[NASA-TM-78683] N78-21051
SWITCHES
Light activated semiconductor switches
[UCRL-80046] N78-21393
SYMBOLIC PROGRAMMING
L-STAR: An interactive, symbolic implementation system
[AD-A050119] N78-21785
SYNCHRONOUS METEOROLOGICAL SATELLITE
SMS/GOES cell and battery data analysis report
[NASA-CR-156739] N78-21606
SYNCHRONOUS SATELLITES
The long-period motion of geosynchronous satellites
N78-21187
SYNOPTIC METEOROLOGY
Approximate solutions to the radiative transfer equation using the Elsasser scheme
[AD-A049933] N78-21703
Selected topics in statistical meteorology
[AD-A050035] N78-21725
A statistical study of synoptic storm activity over the North Pacific in 1975
[AD-A050052] N78-21729
Upper ocean thermal structure forecast evaluation of a model using synoptic data
[AD-A048526] N78-21739
SYNTHANE
Prototype pilot plant operation: Synthane process
[COO-0003-8] N78-21316
Prototype pilot plant operation, synthane process
[COO-0003-10] N78-21317
SYNTHETIC ARRAYS
Analysis of synthetic aperture radar imagery
[NASA-CR-156743] N78-21339
Synthetic Aperture Radar [SAR] data processing
N78-21567
SYSTEM EFFECTIVENESS
Prototype solar heated hot water systems and double-walled heat exchangers: A collection of quarterly reports
[NASA-CR-150591] N78-21591
SYSTEMS ANALYSIS
Accuracy considerations on new Microwave Landing Systems [MLS] from an operational point of view
N78-21081
A 4D approach control using VOR/DME/ILS guidance
N78-21083
Applications of the NAVSTAR global positioning system to military guidance and control
N78-21085
The execution of systematic measurements on plane cascades
[NASA-TM-75278] N78-21413
The First Seasat-A Industrial Users Workshop
[NASA-CR-156149] N78-21573
System design package for solar heating and cooling site data acquisition subsystem
[NASA-CR-150606] N78-21593
Systems integration of marketable subsystems: A collection of progress reports
[NASA-CR-150587] N78-21594
Central Data Processing System [CDPS] user's manual: Solar heating and cooling program
[NASA-CR-150580] N78-21595
Energy systems analysis and development
[BNL-22969] N78-21633
The problem of exit against a flow for dynamical systems
N78-21881
SYSTEMS ENGINEERING
The Joint Tactical Information Distribution System [JTIDS]
N78-21086
Evolution of the 1-mlb mercury ion thruster subsystem
[NASA-TM-73733] N78-21202
Unattended/minimally attended radar study, volume 2
[AD-A049777] N78-21347
Synthesis and analysis of precise spaceborne laser ranging systems, volume 1 --- link analysis
[NASA-CR-156727] N78-21442
Synthesis and analysis of precise spaceborne laser ranging systems, volume 2 --- Spacelab payload
[NASA-CR-156728] N78-21443
High Temperature Turbine Technology Program. Phase 1: Program and system definition. Topical report: Low BTU gas combustor technology development plan
[FE-2290-26] N78-21480
Design of interactive manufacturing and quality systems subject to inspection error using dynamic programming
N78-21481
The effect of modeling depth on reliability prediction for systems subject to a phased mission profile
[AD-A050246] N78-21482
System design package for IBM system one: solar heating and domestic hot water
[NASA-CR-150614] N78-21589
Space electric power design study --- laser energy conversion
[NASA-CR-152031] N78-21590
Prototype solar heated hot water systems and double-walled heat exchangers: A collection of quarterly reports
[NASA-CR-150591] N78-21591
Trenton ICES, volume 1, phase 1
[COO/4212-1/1-VOL-1] N78-21639
Software engineering. Volume 1: Its development and standards
[AD-A049869] N78-21813

Hard X-ray imaging facility for space shuttle: A scientific and conceptual engineering study
[NASA-CR-156736] N78-22016

T

TABLES [DATA]
Tables of Brinell and Vickers hardness values for metallic materials with flat surfaces, and of correction factors [Vickers] for curved surfaces
[SABS-055A-1977] N78-21262
Data compendium for atmospheric laser propagation studies conducted at Cape Canaveral, Florida, February - May 1977
[AD-A050094] N78-21452
TACAN
One-way ranging with TACAN
N78-21079
TAKEOFF
Response to actual and simulated recordings of conventional takeoff and landing jet aircraft
[NASA-CR-145318] N78-21890
TANK GEOMETRY
Constrained sloshing of liquid mercury in a flexible spherical tank
[NASA-TM-78833] N78-21403
TANKS [COMBAT VEHICLES]
Design of two high gain, low profile helical antennas for operation at 918 MHz
[AD-A049950] N78-21386
TARGET ACQUISITION
Target acquisition contours generated for RCAG/BUEC sites in the contiguous United States
[AD-A050978] N78-21335
TARGETS
Range resolution of targets using automatic detectors
[AD-A049442] N78-21348
TASK COMPLEXITY
Payload planning information development study
[NASA-CR-150633] N78-21175
TEA LASERS
An investigation of laser interactions
[AD-A050049] N78-21460
TEARING
Dynamic photoelastic and dynamic finite element analyses of dynamic tear test specimens
[AD-A049780] N78-21504
TECHNOLOGICAL FORECASTING
Area navigation systems and procedures
N78-21091
TECHNOLOGY ASSESSMENT
Special study: Emergency locator transmitters, an overview
[NTSB-AAS-78-1] N78-21063
Research requirements to improve reliability of civil helicopters
[NASA-CR-145335] N78-21093
A turning point in space: Has the time arrived for a national review of our space policy
[AD-A049926] N78-21182
Loose-parts monitoring: Present status of the technology, its implementation in US reactors, and some recommendations for achieving improved performance
[CONF-770902-5] N78-21483
Present status of LANDSAT remote sensing
N78-21529
Use of remote sensing technology provided by the NASA/WFC Chesapeake Bay Ecological Program
N78-21538
Distributed technologies in California's energy future: A preliminary report, volume 2
[LBL-6831-VOL-2] N78-21635
Earthquake prediction uncertainty, and policies for the future: A technology assessment of earthquake prediction
[PB-275581/7] N78-21713
Multi-item scheduling in reparable item inventory systems with reflection programming
[AD-A049553] N78-21808
Technology assessment and forecast report, 8
[PB-276375/3] N78-21989
National Science Foundation --- research projects and technology assessment
[NSF-77-1] N78-22018
TECHNOLOGY TRANSFER
The First Seasat-A Industrial Users Workshop
[NASA-CR-156149] N78-21573
Analyses of methods for the determination of water availability for energy development
[FEA/G-77/059] N78-21580
TECHNOLOGY UTILIZATION
Applications notice --- application of space techniques to earth resources, environment management, and space processing
[AN-OSTA-78-A] N78-21991
TECTONICS
Crustal evolution in the early earth: Basin-forming impacts, crustal dichotomy, and plate tectonics
N78-21685
Source parameters and the static field of earthquakes at near distances
N78-21687
TEKTITES
Study of the ablative effects on tektites: Atmosphere entry of a swarm of tektites --- shielding by hypersonic wake
[NASA-CR-156733] N78-22007
TELECOMMUNICATION
An ECM-resistant communication and ranging system for remotely piloted vehicles
N78-21080
Communications high-order language investigation, volume 1
[AD-A049737] N78-21340
Communications high-order language investigation, volume 2
[AD-A049736] N78-21341
Antenna selection for ionospheric telecommunication systems
[AD-A049549] N78-21364
TELESCOPES
Theoretical contamination of cryogenic satellite telescopes
[NASA-TP-1177] N78-21193
TELEVISION TRANSMISSION
Multichannel still-picture transmission system: TDM transmission of delta-M sounds with still-picture in television channel
[NHK-LABS-NOTE-214] N78-21330
TEMPERATE REGIONS
The modification and application of Kuo's parameterization of cumulus convection in middle latitudes
[NASA-CR-2998] N78-21717
TEMPERATURE
Characterization of solar cells for space applications. Volume 1: Electrical characteristics of OCLI violet solar cells as a function of intensity and temperature
[NASA-CR-156162] N78-21601
TEMPERATURE CONTROL
Liquid rocket engine self-cooled combustion chambers
[NASA-SP-8124] N78-21211
TEMPERATURE DISTRIBUTION
Investigation on temperature distribution near film cooled airfoils
N78-21127
Calculation of temperature distribution in disks and cooling flow in a transient state
N78-21157
Quantitative determination of surface temperatures using an infrared camera
[CONF-770868-2] N78-21916
TEMPERATURE EFFECTS
Division 2: Materials in space engineering. Chapter 3: Influence of the space medium on materials
N78-21178
Laminar boundary layer stability measurements at Mach 7 including wall temperature effects --- conical bodies
[AD-A049535] N78-21415
TEMPERATURE GRADIENTS
Temperature fine-structure in the Southern Ocean
N78-21735
TEMPERATURE INVERSIONS
ORINC: A one-dimensional implicit approach to the inverse heat conduction problem
[ORNL-NUREG-23] N78-21422
TEMPERATURE MEASUREMENT
Local flame temperature measurements by radiative methods
N78-21153
Heat Capacity Mapping Mission [HCMM] launch
[NASA-TM-79429] N78-21191
Heat capacity mapping mission ground measurements --- Dunnigan, California
[E78-10113] N78-21518
TEMPERATURE MEASURING INSTRUMENTS
Thermocouple readout instrument
[PB-275429/9] N78-21436
TEMPERATURE PROFILES
Temperature profile of graphite surface burning in a stream of oxygen
[NASA-TM-75271] N78-21232
TENSILE STRENGTH
Strength enhancement process for prealloyed powder superalloys
[NASA-TM-78834] N78-21266
TENSILE STRESS
Stress relaxation in physically nonlinear polymer materials under combined tension with torsion
N78-21293
TERNARY ALLOYS
The superconductivity of certain ternary molybdenum compounds
[NASA-TM-75250] N78-21958
TERRAIN ANALYSIS
Target acquisition contours generated for RCAG/BUEC sites in the contiguous United States
[AD-A050978] N78-21335
Use of LANDSAT data to assess waterfowl habitat quality
[E78-10120] N78-21524
TEST FACILITIES
A new transient cascade facility for the measurement of heat transfer rates
N78-21149
A sub-scale turbojet test cell for design evaluations and analytical model validation
[AD-A049862] N78-21166
Materials for high-temperature hydrogen-fluorine environments
[Y/DA-7477] N78-21217
TEST STANDS
Digital imagery test set
[AD-A049798] N78-21825
THALAMUS
Effects of ethanol on visual unit activity in the thalamus
[AD-A050922] N78-21754
THEOREMS
Decomposition theorems for differential forms on Hilbert spaces
N78-21885
THERMAL CONDUCTIVITY
Heat transfer in continuum and rarefied gases
N78-21399
Energy transfer at solid surfaces --- thermal emission, thermal conduction and gas-surface energy exchange
N78-21956
THERMAL CONTROL COATINGS
Formulation of electrically conductive thermal-control coatings
[NASA-TP-1218] N78-21216
THERMAL CYCLING TESTS
Engineering evaluation tests of 3-4 ampere-hour sealed lead-acid batteries Elpower, ESB, Eagle-Pitcher, Globe Union and Gates
[AD-A049445] N78-21614
THERMAL EMISSION
Energy transfer at solid surfaces --- thermal emission, thermal conduction and gas-surface energy exchange
N78-21956
THERMAL ENERGY
Trenton ICES, volume 1, phase 1
[COO/4212-1/1-VOL-1] N78-21639
THERMAL INSULATION
Comparison of reusable insulation systems for cryogenically-tanked earth-based space vehicles
[NASA-TM-73668] N78-21190
THERMAL MAPPING
HCMM satellite to take earth's temperature
[NASA-NEWS-RELEASE-78-60] N78-21507
THERMAL PLASMAS
Theory of trace element detection from a static thermal induction plasma
[ATR-78(8209)-1] N78-21233
THERMAL PROTECTION
A review of techniques for the thermal protection of the walls of the combustion chamber and reheating ducts of turboreactors
N78-21134
THERMAL RADIATION
Thermal radiation analysis system [TRASYS 2], programmer's manual
[NASA-CR-151686] N78-21792
THERMAL REACTORS
High thermal efficiency, radiation-based advanced fusion reactors
[EPRI-ER-544] N78-21926
THERMAL RESISTANCE
Fire resistivity and toxicity studies of candidate aircraft passenger seat materials
[NASA-TM-78468] N78-21214
THERMISTORS
Test and development of inflatable spheres instrumented with miniaturized thermistors, accelerometers and pressure transducers
[NASA-CR-2968] N78-21428
THERMOCHEMISTRY
Thermochemistry and kinetics of sulfur containing molecules and radicals
[PB-275721/9] N78-21247
Thermochemical and kinetic data of gaseous metal oxides and their relationship to atmospheric composition
[AD-A050162] N78-21700
THERMOCOUPLES
Thermocouple readout instrument
[PB-275429/9] N78-21436
THERMODYNAMIC EFFICIENCY
Analysis of data and results for the roundrobin flat-plate collector test program
[PB-275576/7] N78-21655
THERMODYNAMIC EQUILIBRIUM
Problems concerning high temperatures in small turbomachines
N78-21121
THERMODYNAMIC PROPERTIES
An investigation of the influence of shock-wave profile on the mechanical and thermal responses of polycrystalline iron
[AD-A049764] N78-21278
Upper ocean thermal structure forecast evaluation of a model using synoptic data
[AD-A048526] N78-21739

THERMODYNAMICS
Effects of thermo-mechanical processing on aluminum-magnesium alloys containing high weight percentage magnesium
[AD-A050092] N78-21275
Torsional pendulum study on several epoxy/diamine polymers
[AD-A050478] N78-21299
Thermodynamics and energy policy
[ORAU-IEA-M-77-18] N78-21643
Critical phenomena of inhomogeneous ising models
N78-21939

THERMOELECTRIC POWER GENERATION
A review of the thermoelectronic laser energy converter [TELEC] program at Lewis Research Center
[NASA-TM-73888] N78-21441
Small Power Systems Solar Electric Workshop Proceedings. Volume 1: Executive report. Volume 2: Invited papers
[NASA-CR-156165] N78-21599

THERMOMECHANICAL TREATMENT
Application of superplastic steels --- thermomechanical forging of carbon steels
[AD-A049469] N78-21270

THERMOPHYSICAL PROPERTIES
Thermophysical properties and behavioral characteristics of phase-change materials
[CONF-770955-2] N78-21218
Thermophysical and transport properties of metals at high pressure and very high temperature
[UCRL-79586] N78-21286
Certain results of determining the temperature dependences of the thermophysical characteristics of composite polymers
N78-21292

THERMOVISCOELASTICITY
Description of the temperature dependence of viscoelastic properties of polymers in the dynamic mode on the basis of linear thermoviscoelasticity theory
N78-21291

THICK FILMS
Quasiparticle interference effects in the tunneling characteristics of thick superconducting films of zinc
N78-21952

THIN FILMS
The exchange constant of germanium substituted yttrium iron garnet films
N78-21251
Intrinsic fluctuation of thin film microbridges
N78-21947
Thin films of gallium arsenide on low-cost substrates
[SAN/1202-77/2] N78-21965

THIN PLATES
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 1: Program summary and data analysis
[NASA-CR-135369] N78-21493
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 2: Crack opening displacement and stress-strain data
[NASA-CR-135370] N78-21494

THORAX
Protection of the cardiopulmonary systems against the injurious effects of acceleration
[AD-A050142] N78-21755

THORIUM
Study of soft alkaline using LANDSAT images of pools and residue with an emphasis on radioactive materials --- Brazil
[E78-10104] N78-21510

THREE BODY PROBLEM
The unitarity constraint on the three-body final states
N78-21896

THREE DIMENSIONAL FLOW
A three-dimensional potential-flow program with a geometry package for input data generation
[NASA-CR-145311] N78-21047
A three-dimensional study of fin-induced shock wave turbulent boundary layer interaction
[AD-A049772] N78-21420

THRESHOLDS
A note on the use of second-order gray level statistics for threshold selection
[AD-A049454] N78-21820

THRUST LOADS
Ball to separator contact forces in angular contact ball bearings under thrust and radial loads
[NASA-CR-2976] N78-21469

THRUST MEASUREMENT
Airflow and thrust calibration of an F100 engine, S/N P680059, at selected flight conditions
[NASA-TP-1069] N78-21112

THUNDERSTORMS
Forecasting thunderstorms over a 2-to-5-h period by statistical methods
[AD-A050005] N78-21723

TIDES
On the tidal oscillations of the liquid core of the earth
[NASA-TP-1223] N78-21691

TILTING ROTORS
Effect of high lift flap systems on the conceptual design of a 1985 short-haul commercial STOL tilt rotor transport
[NASA-TM-78474] N78-21094

TIMBER INVENTORY
Forest resource information system
[E78-10114] N78-21519
Inventory of forest resources [including water] by multi-level sampling --- nine northern Virginia coastal plain counties
[E78-10118] N78-21522

TIME DEPENDENCE
Time-dependent fire behavior of aircraft cabin materials
[AD-A050923] N78-21234

TIME DIVISION MULTIPLEXING
Multichannel still-picture transmission system: TDM transmission of delta-M sounds with still-picture in television channel
[NHK-LABS-NOTE-214] N78-21330

TIME FUNCTIONS
The calculation of RMS values of deviations of aircraft controlled to fly along a desired flight path
N78-21084
Design of a compensation for an ARMA model of a discrete time system
[NASA-CR-156097] N78-21838

TIME SERIES ANALYSIS
On a measure of lack of fit in time series models
[AD-A049397] N78-21860

TIN ALLOYS
Structure and deformation characteristics of rheocast metals --- tin and aluminum alloys
[AD-A049975] N78-21279

TITANATES
Evaluation of lithium titanates as cathode materials
N78-21588

TITANIUM
Titanium/beryllium laminates: Fabrication, mechanical properties, and potential aerospace applications
[NASA-TM-73891] N78-21221

TITANIUM ALLOYS
Optical surface studies of titanium and titanium-aluminum alloys with application to the mechanism of passivity and non-destructive testing
[AD-A050212] N78-21276
Anisothermal oxidation of titanium and its alloy
[AD-A050053] N78-21281
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 1: Program summary and data analysis
[NASA-CR-135369] N78-21493
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 2: Crack opening displacement and stress-strain data
[NASA-CR-135370] N78-21494

TOKAMAK FUSION REACTORS
A theory of electron energy confinement in Tokamaks --- thermal transport code
[AD-A049505] N78-21923
Study of possible separable solutions for plasma transport in ohmically heated Tokamaks
[ORNL/TM-6065] N78-21929
Self-stabilization of a high pressure plasma in toroidal containers with an arbitrary shape for the magnetic axis
[ERDA-TR-311] N78-21931
Induced oscillation instabilities and their role in Tokamaks with injected neutral particles
[ERDA-TR-312] N78-21932
Bounce effects in the instability theory of trapped alpha particles in the Tokamak reactor
[ERDA-TR-313] N78-21933
Tokamak impurity instabilities
[ERDA-TR-314] N78-21934

TOPOGRAPHY
Remote sensing of Gulf Stream using GEOS-3 radar altimeter
[NASA-TP-1209] N78-21737

TOPOLOGY
Stochastic filtering and control
[AD-A049992] N78-21829

TOROIDAL DISCHARGE
Generation and behavior of long-lived field reversing electron rings in strong toroidal fields
N78-21920

TOROIDAL PLASMAS
Self-stabilization of a high pressure plasma in toroidal containers with an arbitrary shape for the magnetic axis
[ERDA-TR-311] N78-21931
Effects of global field errors on ELMO Bumpy Torus
[ORNL/TM-6075] N78-21935

TORSION
Stress relaxation in physically nonlinear polymer materials under combined tension with torsion
N78-21293

TORSIONAL STRESS
Torsional pendulum study on several epoxy/diamine polymers
[AD-A050478] N78-21299
The torsional analysis of steady state and transient wave propagation in elastic cylinders
N78-21487
Simple torsion test for shear moduli determination of orthotropic composites
[NASA-TM-78485] N78-21490

TOWERS
AFAL tower characterization facility: 4 km weather instrumentation tower
[AD-A049525] N78-21067

TOXICITY
Antifouling activity of phytotoxic compounds and experimental polymeric algicides
[MRL-R-698] N78-21747

TRACE ELEMENTS
Theory of trace element detection from a static thermal induction plasma
[ATR-78(8209)-1] N78-21233

TRACKING [POSITION]
Distributed sensor networks
[AD-A050160] N78-21576
Identification and tracing of water masses with an application near the Galapagos Islands
N78-21736

TRAILING EDGES
The influence of jets of cooling air exhausted from the trailing edges of a supercritical turbine cascade on the aerodynamic data
N78-21148

TRAINING DEVICES
Training device design: The simulation/ stimulation controversy
[AD-A049973] N78-21169

TRANSDUCERS
Experimental investigation of the effects of fluid loading on flexural waves in plates
[AD-A050020] N78-21417

TRANSFORMATIONS [MATHEMATICS]
Elliptic systems and numerical transformations
[NASA-TM-79433] N78-21840
Statistical analysis of a forecasting model using one-dimensional nonlinear transformations
N78-21843
Reduction of a large polynomial matrix to Smith-normal-form by unimodular block-partitioning transformation
[AD-A049453] N78-21845
Direct transformation of variational problems into cauchy systems. 2: Scalar-semi-quadratic case
[AD-A049527] N78-21848

TRANSIENT RESPONSE
Transient analysis of a finite length cylindrical scatterer very near a perfectly conducting ground, part 1
[AD-A050143] N78-21342
Heat transfer research and power cycle transient modeling
[COO-2641-4] N78-21424

TRANSITION METALS
Studies of transition metal analogs of hexaborane [10]. Nuclear magnetic resonance studies of heptaborane species
N78-21249
Friction and metal transfer for single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1191] N78-21294
Wear of single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1198] N78-21295
Photoemission studies of layered transition metal dichalcogenides
N78-21948

TRANSITION POINTS
Higher order effects, stability and transition in vertical natural convection flows
N78-21394

TRANSMISSION LINES
Numerical results or multiconductor transmission line networks
[AD-A049451] N78-21349
Small aperture on a multiconductor transmission line filled with inhomogeneous dielectrics --- penetration of electromagnetic pulse
[AD-A050099] N78-21359

TRANSONIC FLOW
A vectorization of the Jameson-Caughey NYU transonic swept-wing computer program FLO-22-V1 for the STAR-100 computer
[NASA-TM-78665] N78-21050
Numerical study of transonic flow over oscillating airfoils using the full potential equation
[NASA-TP-1120] N78-21055

TRANSPIRATION
The influence of transpiration cooling on turbine blade boundary layer
N78-21130
Experimental evaluation of a transpiration cooled nozzle guide vane
N78-21131

TRANSPORT AIRCRAFT
Factors affecting the retirement of commercial transport jet aircraft
[NASA-CR-152115] N78-21092

Effect of high lift flap systems on the conceptual design of a 1985 short-haul commercial STOL tilt rotor transport
[NASA-TM-78474] N78-21094
Fuel conservation merits of advanced turboprop transport aircraft
[NASA-CR-152096] N78-21095
TRANSPORT PROPERTIES
Thermophysical and transport properties of metals at high pressure and very high temperature
[UCRL-79586] N78-21286
A theory of electron energy confinement in Tokamaks --- thermal transport code
[AD-A049505] N78-21923
Study of possible separable solutions for plasma transport in ohmically heated Tokamaks
[ORNL/TM-6065] N78-21929
Development and application of data processing and pattern recognition methods
[AD-A049846] N78-21982
TRANSPORT THEORY
Software development: Stratosphere modeling
[NASA-CR-156722] N78-21692
Some highlights of theoretical and computational plasma physics, part 2
[UCRL-79600-PT-2] N78-21936
TRANSPORTATION
Performance and design of transportation-cooled turbine blading
N78-21129
Optimal dispatching of a finite capacity shuttle
[AD-A049595] N78-21824
TRANSPORTATION ENERGY
Alternative fuels for transportation: Implications of the broad-cut option
[UCRL-52313] N78-21322
Fuel and energy price forecasts: Quantities and long-term marginal prices, volume 1
[EPRI-EA-433-VOL-1] N78-21637
TRANSVERSE OSCILLATION
Transverse oscillations of a circular cylinder in uniform flow, part 1
[AD-A049825] N78-21416
TRAPPED MAGNETIC FIELDS
Generation and behavior of long-lived field reversing electron rings in strong toroidal fields
N78-21920
TRAPPED PARTICLES
Bounce effects in the instability theory of trapped alpha particles in the Tokamak reactor
[ERDA-TR-313] N78-21933
Binding energy and effectiveness mass of charged particles trapped on surfaces
[AD-A049945] N78-21964
TRAVELING WAVE TUBES
Calculation of optimum operating parameters for a gyrotron traveling wave amplifier
[AD-A049506] N78-21375
Klystron-twt hybrid efficiency improvement
[AD-A050125] N78-21377
TREES [MATHEMATICS]
Multicriteria integer zero-one programming: A tree-search type algorithm
[AD-A050244] N78-21807
TRIANGULATION
UHF DF triangulation system for control and guidance of military aircraft
N78-21077
TROPICAL REGIONS
Study of vertical movement and associative precipitation by extratropical perturbations in South America
[E78-10107] N78-21513
TUBE HEAT EXCHANGERS
Space shuttle L-tube radiator testing
[NASA-CR-151695] N78-21196
Development of a ceramic tube heat exchanger with relaxing joint
[FE-2556-06] N78-21423
TUBES
Advanced solid electrolyte cell for CO2 and H2O electrolysis --- for extended duration manned spaceflights
[NASA-CR-152093] N78-21235
TUNING
High-resolution spectroscopy using tunable diode lasers: Techniques and applications
[LA-UR-77-2222] N78-21917
TURBINE BLADES
Project optimisation of military gas turbines with respect to turbine life
N78-21120
Hot cascade test results of cooled turbine blades and their application to actual engine conditions
N78-21125
Investigations of the local heat transfer coefficient of a convection cooled rotor blade
N78-21126
Investigation on temperature distribution near film cooled airfoils
N78-21127
Erosion prevention and film cooling on vanes
N78-21128
Performance and design of transportation-cooled turbine blading
N78-21129
The influence of transpiration cooling on turbine blade boundary layer
N78-21130
Heat transfer characteristics of the closed thermosyphon system
N78-21132
Heat transfer from turbine and compressor discs
N78-21133
New materials for high temperature turbines: ONERA's DS composites confronted with the blade problems
N78-21139
High temperature corrosion of Ni-base for turbine blades alloys in sulphate-chloride containing environments
N78-21140
Protection of cooled blades of complex internal structure
N78-21141
Finite element analysis of some problems arising in cooled turbine blades
N78-21144
A new transient cascade facility for the measurement of heat transfer rates
N78-21149
New computation method of turbine blades film cooling efficiency
N78-21154
The effect of free-stream turbulence upon heat transfer to turbine blading
N78-21155
Effluent characterization from a conical pressurized fluid bed
[NASA-TM-73897] N78-21596
TURBINE ENGINES
Protection of cooled blades of complex internal structure
N78-21141
Trends of future turbine life prediction: Time phase automated analysis and test verification
N78-21143
TURBOFANS
Comparison of the noise characteristics of two low pressure ratio fans with a high throat Mach number inlet
[NASA-TM-73880] N78-21108
TURBOJET ENGINES
Fuel pressure increase limiter
[AD-A049393] N78-21117
A sub-scale turbojet test cell for design evaluations and analytical model validation
[AD-A049862] N78-21166
TURBOMACHINERY
FLOWNET: A computer program for calculating secondary flow conditions in a network of turbomachinery
[NASA-TM-73774] N78-21791
TURBULENCE
A small aircraft gust-probe system
[PB-276429/8] N78-21106
TURBULENCE METERS
Mean velocity, turbulence intensity and turbulence convection velocity measurements for a convergent nozzle in a free jet wind tunnel
[NASA-CR-2949] N78-21058
TURBULENT BOUNDARY LAYER
Problems of hydrodynamics and heat exchange
[NASA-TT-F-17060] N78-21409
Experimental study of the laminar-turbulent transition of a concave wall in a parallel flow
[NASA-TM-75243] N78-21412
Numerical calculation of the stability of parallel flows
[AD-A049983] N78-21418
A three-dimensional study of fin-induced shock wave turbulent boundary layer interaction
[AD-A049772] N78-21420
A numerical investigation of the boundary layer of an atmospheric mesoscale vortex
N78-21688
TURBULENT DIFFUSION
Atmospheric diffusion: Similarity theory and empirical derivations for use in boundary layer diffusion problems
[AD-A050027] N78-21701
TURBULENT FLOW
Effect of turbulent jet mixing on the static lift performance of a power augmented ram wing
[AD-A049620] N78-21060
The influence of coolant turbulence intensity of film cooling effectiveness
N78-21136
The effect of free-stream turbulence upon heat transfer to turbine blading
N78-21155
Investigation of the turbulent flows of two-phase media
[NASA-TT-F-17059] N78-21408
TWO PHASE FLOW
Problems of hydrodynamics and heat exchange
[NASA-TT-F-17060] N78-21409
Natural circulation calculation: Single-phase and two-phase flow in pipes
[DOE-TR-15] N78-21425
Analytical models and experimental studies of centrifugal pump performance in two-phase flow. Key phase report
[EPRI-NP-170] N78-21477

U

U.S.S.R.
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 24
[JPRS-70928] N78-21761
U.S.S.R. SPACE PROGRAM
Space orbits of collaboration --- international cooperation and the U.S.S.R. space program
[NASA-TM-75096] N78-21176
Translations on USSR science and technology: Physical sciences and technology, no. 33
[JPRS-70946] N78-21183
A runaway satellite is going to crash 20 April --- Cosmos 849 satellite
N78-21184
Laboratory in space --- Salyut-6 space station
N78-21185
ULTRASONIC FLAW DETECTION
Evaluation of flaw indications by ultrasonic pulse amplitude and phase spectroscopy
[ORNL-TR-4355] N78-21484
ULTRASONIC RADIATION
Audible and ultrasonic acoustic emissions from composite solid propellants
[AD-A049517] N78-21304
ULTRAVIOLET LASERS
Optical conversion processes
[AD-A049583] N78-21448
Small scale discharge studies
[AD-A049551] N78-21456
ULTRAVIOLET RADIATION
User's guide to the Nimbus-4 backscatter ultraviolet experiment data sets
[NASA-TM-78069] N78-21694
Algae, ultraviolet light, and the production of trace gases
[AD-A049441] N78-21748
Analysis of EUV solar line profiles of Si-2 and Si-3
N78-22009
ULTRAVIOLET SPECTROMETERS
Research directed toward improved echelles for the ultraviolet --- large space teslescope spectrographs
[NASA-CR-156732] N78-21427
ULTRAVIOLET SPECTROSCOPY
Ultraviolet photoemission studies of formaldehyde and related molecules absorbed on Ru[110]
[AD-A049661] N78-21239
UNCONTROLLED REENTRY [SPACECRAFT]
A runaway satellite is going to crash 20 April --- Cosmos 849 satellite
N78-21184
UNDERGROUND STORAGE
Design method for heat loss calculation for in-ground heat storage tanks
[COO-2923-3] N78-21625
UNDERWATER ACOUSTICS
Acoustic remote probing of the environment --- atmospheric and underwater acoustic data acquisition
N78-21542
UNDERWATER COMMUNICATION
Remote in-situ elemental analysis systems for underwater application --- measuring pollutants in the chesapeake bay
N78-21546
UNIFORM FLOW
Transverse oscillations of a circular cylinder in uniform flow, part 1
[AD-A049825] N78-21416
UNITED STATES OF AMERICA
Application of wheat yield model to United States and India --- Great Plains
[E78-10109] N78-21515
UNSTEADY FLOW
Enhancement of heat transfer by flow pulsations
N78-21398
UNSWEPT WINGS
Correlation of laser velocimeter measurements over a wing with results of two prediction techniques --- in the Langley V/STOL tunnel
[NASA-TP-1168] N78-21410
UPWELLING WATER
Coastal upwelling ecosystems analysis, data report 39, Joint 2: R/V Thomas G. Thompson cruise 108 leg 1, CTD measurements off the coast of Peru near Cabo Nazca, April - May 1976
[PB-276532/9] N78-21742
Coastal upwelling ecosystems analysis, data report 40. Joint 2: R/V Thomas G. Thompson cruise 108 legs 2 and 3, CTD measurements off the coast of Peru near Cabo Nazca, May - June 1976
[PB-276533/7] N78-21743
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from JOINT 2 R/V ALPHA HELIX, Leg O, 5-20 March 1976
[PB-276297/9] N78-21745
Coastal upwelling ecosystems analysis. Technical report 34: Physical and biological measurements, 29 July - 5 August 1973
[PB-276486/8] N78-21746

URANIUM
Thermophysical and transport properties of metals at high pressure and very high temperature
[UCRL-79586] N78-21286
Study of soft alkaline using LANDSAT images of pools and residue with an emphasis on radioactive materials --- Brazil
[E78-10104] N78-21510

URBAN PLANNING
Application of a computerized environmental information system to master and sector planning
N78-21561

URBAN TRANSPORTATION
Evaluation of noise nuisance: A study of willingness to receive payment for noise introduced into the home
[PB-276418/1] N78-21658

USER MANUALS [COMPUTER PROGRAMS]
The N-BOD2 user's and programmer's manual
[NASA-TP-1145] N78-21200
Central Data Processing System [CDPS] user's manual: Solar heating and cooling program
[NASA-CR-150580] N78-21595
SEMANOL [76] reference manual, volume 2
[AD-A049473] N78-21794
PDP 11 image processing software
[AD-A049586] N78-21799
PLOT user's manual
[ORNL/CSD/TM-41] N78-21816

UTAH
Evaluation of LANDSAT MSS vs TM simulated data for distinguishing hydrothermal alteration
[NASA-CR-156168] N78-21569

UTILITIES
Projected 1977 - 1978 winter electric load-supply situation, contiguous United States
[PB-276269/8] N78-21621
The long-run incremental cost of electric utilities
[PB-276082/5] N78-21660
The cost of water supply and water utility management, volume 1
[PB-276639/2] N78-21992
The cost of water supply and water utility management, volume 2
[PB-276640] N78-21993

V

VACUUM CHAMBERS
Effect of facility background gases on internal erosion of the 30-cm Hg ion thruster
[NASA-TM-73803] N78-21205

VACUUM EFFECTS
Division 2: Materials in space engineering. Chapter 3: Influence of the space medium on materials
N78-21178

VACUUM TESTS
Friction and metal transfer for single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1191] N78-21294

VALUE ENGINEERING
Performance predictors for value engineering program management
[AD-A049696] N78-21972

VAPOR DEPOSITION
Metastable metallic superconductors with high transition temperatures and composite superconductors
[AD-A050055] N78-21282
Thin films of gallium arsenide on low-cost substrates
[SAN/1202-77/2] N78-21965

VAPOR PRESSURE
Modeling of Rankine cycle/vapor compression cycle cooling systems for solar energy applications
N78-21587

VARIABLE GEOMETRY STRUCTURES
High temperature H2-Air variable geometry combustor and turbine: Test facility and measurements
N78-21137

VARIATIONAL PRINCIPLES
Discrete variational techniques in finite mathematics
N78-21834
Direct transformation of variational problems into Cauchy systems. 1: Scalar-quadratic case
[AD-A049526] N78-21847

VECTORS [MATHEMATICS]
Accuracy limitation on strapdown calculations in a coning environment due to a given approximation to the body rate vector
[SAND-77-0726] N78-21069

VEGETATION
Plant cover, soil temperature, freeze, water stress, and evapotranspiration
[E78-10101] N78-21509
LANCHAD: Remote sensing of the N'Djamena area and the Logone-Chari confluent
[NASA-TM-75087] N78-21570

VEGETATION GROWTH
Inferring nutrient loading of estuarine systems by remote sensing of aquatic vegetation
N78-21552
Role of remote sensing in documenting living resources
N78-21554

VEHICLE WHEELS
A perturbation method for predicting amplitudes of nonlinear wheel shimmy
N78-21464

VERTICAL AIR CURRENTS
Higher order effects, stability and transition in vertical natural convection flows
N78-21394
Study of vertical movement and associative precipitation by extratropical perturbations in South America
[E78-10107] N78-21513

VERTICAL TAKEOFF AIRCRAFT
Experimental investigation of effect of jet decay rate on jet-induced pressures on a flat plate
[NASA-CR-2979] N78-21096
Theoretical flow characteristics of inlets for tilting-nacelle VTOL aircraft
[NASA-TP-1205] N78-21114

VIDICONS
Electron beam addressed arrays of infrared bolometers
[AD-A049550] N78-21905

VIRGINIA
Inventory of forest resources [including water] by multi-level sampling --- nine northern Virginia coastal plain counties
[E78-10118] N78-21522
Progress toward a circulation atlas for application to coastal water siting problems
[VIMS-CONTRIB-823] N78-21560

VISCOELASTICITY
Description of the temperature dependence of viscoelastic properties of polymers in the dynamic mode on the basis of linear thermoviscoelasticity theory
N78-21291
The stress clock function in viscoelasticity
N78-21486

VISCOPLASTICITY
Finite viscoplastic deflections of an impulsively loaded plate by the mode approximation technique
[AD-A049827] N78-21499

VISCOUS FLOW
Flow of viscous gas in the region of a slot with strong suction
[NASA-TM-75241] N78-21411
Numerical investigation of the effect of a Coriolis force on the stability of plane Poiseuille flow
[AD-A049521] N78-21414

VISUAL ACUITY
Effects of ethanol on visual unit activity in the thalamus
[AD-A050922] N78-21754

VISUAL PERCEPTION
How big the moon, how fat the eye?
[AD-A050211] N78-21756
Visual-proprioceptive cue conflicts in the control of remotely piloted vehicles
[AD-A049706] N78-21770

VLASOV EQUATIONS
Theory and simulation of the stability of Bernstein-Greene-Kruskal waves --- vlasov equations and laplace transformation
N78-21918

VOICE COMMUNICATION
Traffic flow, performance and interface characterization study for Europe
[AD-A049462] N78-21353
Performance measurements of the CVSD speech coding algorithm
[AD-A050163] N78-21362

VOLTAGE CONVERTERS [DC TO DC]
A 10kW lightweight dc converter: Technology feasibility study for lightweight megawatt range converters
[AD-A049937] N78-21384

VOLTERRA EQUATIONS
Application and numerical solution of Abel-type integral equations
[AD-A049396] N78-21861

VORTICES
On the period of the coherent structure in boundary layers at large Reynolds numbers
[NASA-TM-78477] N78-21407
A numerical investigation of the boundary layer of an atmospheric mesoscale vortex
N78-21688
Internal gravity wave generation by vortex wakes
[AD-A049515] N78-21699
Installation and test of Doppler acoustic sensor
[AD-A049562] N78-21893

W

WALL FLOW
Experimental study of the laminar-turbulent transition of a concave wall in a parallel flow
[NASA-TM-75243] N78-21412
Analytical and numerical investigation of structural response of compliant wall materials
[NASA-CR-156151] N78-21491

WALL TEMPERATURE
Laminar boundary layer stability measurements at Mach 7 including wall temperature effects --- conical bodies
[AD-A049535] N78-21415

WALLS
A review of techniques for the thermal protection of the walls of the combustion chamber and reheating ducts of turboreactors
N78-21134
Investigation of the turbulent flows of two-phase media
[NASA-TT-F-17059] N78-21408

WALSH FUNCTION
An incoherent optical implementation of the two-dimensional Walsh transform
N78-21911

WARNING SYSTEMS
National Severe Storms Laboratory: Program and history
[PB-276402/5] N78-21730

WASHINGTON
Water resources data for Washington, water year 1976. Volume 1: Western Washington
[PB-275886/0] N78-21581
Water resources data for Washington, water year 1976. Volume 2: Eastern Washington
[PB-275887/8] N78-21582

WASTE UTILIZATION
Fuel gas production from animal waste, phase 1
[COO-2991-17] N78-21321

WATER
Advanced solid electrolyte cell for CO2 and H2O electrolysis --- for extended duration manned spaceflights
[NASA-CR-152093] N78-21235
Preliminary design package for solar hot water system
[NASA-CR-150617] N78-21603

WATER CIRCULATION
Natural circulation calculation: Single-phase and two-phase flow in pipes
[DOE-TR-15] N78-21425
Progress toward a circulation atlas for application to coastal water siting problems
[VIMS-CONTRIB-823] N78-21560

WATER CURRENTS
Identification and tracing of water masses with an application near the Galapagos Islands
N78-21736

WATER FLOW
A 1/3 scale air-water pump program, analytical pump performance model. Volume 1: Key phase report
[EPRI-NP-160-VOL-1] N78-21478
On the stochastic modeling of daily streamflows
N78-21508

WATER MANAGEMENT
Analyses of methods for the determination of water availability for energy development
[FEA/G-77/059] N78-21580
Dynamic hyperfiltration membranes for high-temperature spacecraft wash water recycle
[NASA-CR-151689] N78-21767
The cost of water supply and water utility management, volume 1
[PB-276639/2] N78-21992
The cost of water supply and water utility management, volume 2
[PB-276640] N78-21993

WATER POLLUTION
Chemical and physical properties of refined petroleum products
[PB-277100/4] N78-21312
HCMM energy budget data as a model input for assessing regions of high potential groundwater pollution
[E78-10111] N78-21516
Remote in-situ elemental analysis systems for underwater application --- measuring pollutants in the chesapeake bay
N78-21546
Water resources data for California, water year 1976. Volume 3: Southern central valley basins, and the great basin from Walker River to Truckee River
[PB-276354/8] N78-21586
Effluent monitoring procedures: Metals analyses. Student reference manual
[PB-275391/1] N78-21674
Effluent monitoring procedures: Metals analyses. Staff guide for conducting the course
[PB-275393/7] N78-21675

WATER QUALITY
Remote sensing of water quality
N78-21541
Relationship of land use to water quality in the Chesapeake Bay region --- water sampling and photomapping river basins
N78-21544
Water quality and shellfish sanitation --- Patuxent and Choptank River watersheds
N78-21550

WATER RESOURCES
An integrated study of earth resources in the state of California using remote sensing techniques
[E78-10115] N78-21520
Inventory of forest resources [including water] by multi-level sampling --- nine northern Virginia coastal plain counties
[E78-10118] N78-21522

WATER TEMPERATURE
Prototype solar heated hot water systems and double-walled heat exchangers: A collection of quarterly reports
[NASA-CR-150591] N78-21591

WATER TREATMENT
The application of wind energy systems to desalination
[PB-276174/0] N78-21620
Study of treatment methods for geothermal fluids
[LBL-6337] N78-21622

WATER WAVES
Measurement of near sea surface turbulence and possible wave influence
[AD-A049951] N78-21704
Wave measurement and implementation aboard ship
[PB-276070/0] N78-21741

WATERFOWL
Use of LANDSAT data to assess waterfowl habitat quality
[E78-10120] N78-21524

WATERWAVE ENERGY CONVERSION
Integrating wave power into the electricity supply system
[RR-20] N78-21609

WAVE ATTENUATION
Computation of groundwave attenuation over irregular and inhomogeneous ground at low and medium frequencies
[BBC-RD-1978/7] N78-21332

WAVE INTERACTION
A study of the interaction of X-rays and acoustic waves in solids
N78-21888

WAVE PROPAGATION
A study of the Peninsula Method for the controlled artificial generation of ULF waves in the ionosphere and magnetosphere
[AD-A049514] N78-21354
A study of the waveguide mode excitation and propagation in a parallel plate transmission line
[AD-A050118] N78-21360
A general approach for kinematic waves
[AD-A050077] N78-21367
Data compendium for atmospheric laser propagation studies conducted at Cape Canaveral, Florida, February - May 1977
[AD-A050094] N78-21452
The torsional analysis of steady state and transient wave propagation in elastic cylinders
N78-21487
A study of the interaction of X-rays and acoustic waves in solids
N78-21888
The evaluation and energy propagation of relativistic electron-nucleus Bremsstrahlung and virtual photon spectra
N78-21895
On the theory and analysis of occultation light curves
N78-22005

WAVEGUIDES
A study of the waveguide mode excitation and propagation in a parallel plate transmission line
[AD-A050118] N78-21360

WAVELENGTHS
Continued development of doped-germanium photoconductors for astronomical observations at wavelengths from 30 to 120 micrometers
[NASA-CR-152125] N78-22000

WEAPON SYSTEMS
A multi-sensor implementation for navigation, position location, position update, reconnaissance, and weapon delivery: AN/ARN-101[V]
N78-21082
IEMCAP implementation study, volume I
[AD-A049739] N78-21344

WEAR
Study of surface fatigue wear by exoelectron emission
[AD-A049927] N78-21476

WEAR TESTS
Wear of single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1198] N78-21295

WEATHER
World weather program. Plan for fiscal year 1978
[PB-276479/3] N78-21718
Methods for estimating areal precipitation in mountainous areas
[PB-276140/1] N78-21731

WEATHER FORECASTING
The development of a mesoscale semi-implicit numerical model
N78-21716
Forecasting thunderstorms over a 2-to-5-h period by statistical methods
[AD-A050005] N78-21723
A statistical study of synoptic storm activity over the North Pacific in 1975
[AD-A050052] N78-21729
National Severe Storms Laboratory: Program and history
[PB-276402/5] N78-21730
A report on the Chesapeake Bay region NOWCASTING experiment
[PB-277102/0] N78-21732
Mariners weather log, volume 21, number 6, November 1977
[PB-276467/8] N78-21734

WEATHER MODIFICATION
Physical mechanisms of extra area effects from weather modification
N78-21715

WEATHERING
The physical mechanisms responsible for the weathering of epoxy resins and GFR epoxy resins
[AD-A049796] N78-21297

WEIGHTING FUNCTIONS
Distribution of a sum of weighted chi-square variables
[AD-A049986] N78-21855

WEIGHTLESSNESS
Germination of pine seed in weightlessness [investigation in Kosmos 782]
[NASA-TM-75281] N78-21172
Tsiolkovsky's Ideas on Cosmonautic Problems
[NASA-TT-F-16118] N78-21177
Separation of lymphocytes by electrophoresis under terrestrial conditions and at zero gravity, phase 3
[NASA-CR-151702] N78-21753

WELD STRENGTH
Shear strength of fillet welds in aluminum alloy 2219 --- for use on the solid rocket motor and external tank
[NASA-TM-78168] N78-21495

WETLANDS
Use of LANDSAT data to assess waterfowl habitat quality
[E78-10120] N78-21524
Coastal wetlands along Lake Ontario and the St. Lawrence in Jefferson County, New York
[PB-276031/2] N78-21744

WHEAT
Application of wheat yield model to United States and India --- Great Plains
[E78-10109] N78-21515
Estimated winter wheat yield from crop growth predicted by LANDSAT --- Kansas
[E78-10112] N78-21517

WHITE DWARF STARS
Spectrophotometric investigations of white dwarf stars
N78-21994

WIND [METEOROLOGY]
Distributed technologies in California's energy future, volume 1
[LBL-6831-VOL-1] N78-21623

WIND PRESSURE
Compilation of wind tunnel coefficients for parabolic reflectors
[NASA-CR-156161] N78-21057

WIND TUNNEL MODELS
A brief examination of the flow external to an F-111 intake at Mach 1.6
[ARL/ME-NOTE-357] N78-21054
Transonic wind tunnel tests on two-dimensional aerofoil sections. Determination of pressure distribution and drag for an aerofoil with a modified NACA 65 sub2-215 section in FFA wind tunnel S5, part 2
[FFA-TN-AU-725] N78-21062

WIND TUNNEL TESTS
Wind tunnel performance tests of coannular plug nozzles --- in the Langley 8 x 6 ft. supersonic wind tunnel
[NASA-CR-2990] N78-21044
Comparison of aerodynamic data measured in air and Freon-12 wind-tunnel test mediums
[NASA-TM-78671] N78-21052
Low-speed aerodynamic characteristics from wind-tunnel tests of a large-scale advanced arrow-wing supersonic-cruise transport concept
[NASA-CR-145280] N78-21053
Compilation of wind tunnel coefficients for parabolic reflectors
[NASA-CR-156161] N78-21057
Mean velocity, turbulence intensity and turbulence convection velocity measurements for a convergent nozzle in a free jet wind tunnel
[NASA-CR-2949] N78-21058
Summer faculty systems design program. Integrating wind tunnels and computers. Volume 2: Details of summer design study USAF/OSR/ASEE
[AD-A050071] N78-21167
Summer faculty systems design program. Integrating wind tunnels and computers. Volume 1: Executive summary. USAF/OSR/ASEE
[AD-A050072] N78-21171
APL radiometer wind tunnel test program
[BSR-4188] N78-21401
APL radiometer wind tunnel test program with simulated aircraft radome
[BSR-4230] N78-21402
Correlation of laser velocimeter measurements over a wing with results of two prediction techniques --- in the Langley V/STOL tunnel
[NASA-TP-1168] N78-21410

WIND VELOCITY
A method of calibrating wind velocity sensors with a modified gas flow calibrator
[NASA-TM-78707] N78-21426

WINDPOWER UTILIZATION
The application of wind energy systems to desalination
[PB-276174/0] N78-21620
Windmill power for city people
[PB-275658/3] N78-21654

WINDPOWERED GENERATORS
The application of wind energy systems to desalination
[PB-276174/0] N78-21620

WINDSHIELDS
Evaluation of windshield materials subjected to simulated supersonic flight
[AD-A049981] N78-21101

WING FLAPS
Effect of high lift flap systems on the conceptual design of a 1985 short-haul commercial STOL tilt rotor transport
[NASA-TM-78474] N78-21094

WING PLANFORMS
Effect of turbulent jet mixing on the static lift performance of a power augmented ram wing
[AD-A049620] N78-21060

WIRE
Excitation of a wire in a rectangular cavity. Part 1: Theory
[AD-A050073] N78-21365
Excitation of a wire in a rectangular cavity. Part 2: Computer documentation
[AD-A050074] N78-21366

X

X RAY ANALYSIS
An X-ray study of continuous ordering and its kinetics in binary alloys
N78-21260

X RAY DIFFRACTION
X-ray diffraction studies of helium four
N78-21226

X RAY SCATTERING
Improved calculations of X-ray and inelastic electron scattering Compton profiles
[AD-A049513] N78-21960

X RAYS
A study of the interaction of X-rays and acoustic waves in solids
N78-21888

Y

YAG LASERS
Study of metastable rare gas collisions with halogens
[AD-A049829] N78-21449
Preparation of rare earth doped laser materials
[AD-A049697] N78-21454

YTTRIUM-IRON GARNET
The exchange constant of germanium substituted yttrium iron garnet films
N78-21251

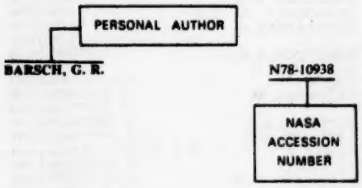
Z

ZINC
Remote sensing applied to geological mapping; comparative geomorphology and identification of mineral zones of zinc and lead in the region of Vazante, MG --- Brazil
[E78-10108] N78-21514
Quasiparticle interference effects in the tunneling characteristics of thick superconducting films of zinc
N78-21952

ZINC OXIDES
Formulation of electrically conductive thermal-control coatings
[NASA-TP-1218] N78-21216

PERSONAL AUTHOR INDEX

Typical Personal Author Index Listing



Listings in this Index are arranged alphabetically by personal author. The NASA accession number denotes the number by which the citation is identified.

A

AARONS, D. N78-21877
ABBASCHIAN, G. J. N78-21279
ABBOTT, J. M. N78-21108
ABEL, J. E. N78-21306
ABOLFACHI, F. N78-21975
ABRAMS, G. N78-21572
ABRAMS, M. J. N78-21569
ABURDZHANIYA, K. D. N78-21931
ACKERMAN, S. E. N78-21713
ADAMO, M. N78-21385
ADAMS, N. J. N78-21379
ADAMS, W. K. N78-21992
N78-21993
ADAMSON, A. W. N78-21243
ADLER, I. N78-21526
AGRAWAL, V. N78-21636
AHR, H. A. N78-21567
AHUJA, N. N78-21820
N78-21826
AKHMETOV, Y. M. N78-21117
ALDRICH, R. C. N78-21522
ALGAZI, R. N78-21520
ALGER, D. L. N78-21441
ALIC, J. A. N78-21271
ALLEN, R. J. N78-21406
ALTENHOF, B. D. N78-21725
ALTSHULLER, A. P. N78-21679
ANANIA, G. L. N78-21300
ANDERSON, C. J. N78-21322
ANDERSON, D. N78-21553
ANDERSON, E. R. N78-21796
ANDERSON, J. J. N78-21736
ANDERSON, R. R. N78-21552
N78-21554
ANDERSSEN, R. S. N78-21861
ANDERTON, D. N78-21681
ANDREU, R. C. N78-21787
ANDREWS, M. N78-21786
ANDRIES, J. N78-21132
ANTONSEN, T., JR. N78-21923
APPEL, B. R. N78-21248
ARAGAO, M. R. D. S. N78-21513
ARMANTROUT, J. D. N78-21606
ARMSON, R. N78-21608
ARTUSY, T. M. N78-21440
ARTYUKHIN, P. I. N78-21231
ASHARE, E. N78-21321
ASHBEE, K. H. G. N78-21297
ASKADSKII, A. A. N78-21290
ATTWATER, C. R. N78-21625
N78-21645
AUERBACH, R. A. N78-21899
AUGENSTEIN, D. C. N78-21319
N78-21321
AULT, G. M. N78-21122
AUSHERMAN, D. A. N78-21567
AUTHIER, B. N78-21957

B

BACHE, T. C. N78-21705
BACHLE, C. F. N78-21471
BACKMAN, D. G. N78-21279
BADALOV, T. A. N78-21693
BAILEY, B. N78-21618
BAKER, R. D. N78-21906
BAKIR, S. T. N78-21870
BALASUBRAMANIAN, R. N78-21491
BALLARD, J. A. N78-21696
BANKS, B. A. N78-21202
BANKSTOW, C. P. N78-21244
BANNISTER, J. R. N78-21768
BARATH, F. N78-21565
BARBACCI, M. N78-21774
BARBARIKA, H. N78-21682
BARBER, J. R. N78-21190
BARCLAY, S. N78-21195
BARDINET, C. N78-21570
BARE, J. N78-21566
BARGMANN, R. E. N78-21874
BARNES, J. C. N78-21521
BARNETT, T. N78-21164
BARNOSKI, M. N78-21458
BARR, W. L. N78-21928
BARRETT, L. D. N78-21093
BARROW, H. G. N78-21578
BARTON, E. D. N78-21742
BARTON, J. R. N78-21277
BASS, A. E. N78-21745
BATES, D. R., JR. N78-21072
BAUM, K. N78-21240
BAUM, P. E. N78-21615
BAY, S. M. N78-21559
BAYANOV, B. F. N78-21390
BAYLEY, F. J. N78-21129
N78-21155
BEALL, S. E., JR. N78-21648
BEARMAN, T. C. N78-21988
BEATTY, J. N78-21757
N78-21759
BEAUMONT, T. E. N78-21328
BEAVEN, P. J. N78-21328
BECKER, A. N78-21081
BECKER, H. N78-21065
BECKERS, P. N78-21144
BECKMANN, R. C. N78-21070
BECKNER, F. L. N78-21567
BEDDINI, R. A. N78-21307
BEGUN, M. N78-21355
BELAYGUE, P. N78-21121
BELFIELD, W. N78-21362
BELL, W. A. N78-21304
BELT, R. F. N78-21434
BELZ, F. C. N78-21794
N78-21795
BENDER, T. N78-21657
BENECCHI, S. N78-21153
BENSON, S. W. N78-21247
BENTLEY, C. B. N78-21583
BERGER, T. A. N78-21235
BERKOPEC, F. D. N78-21373
BERKOWITZE, P. T. N78-21240
BERNING, P. T. N78-21793
BERRA, P. B. N78-21849
BERRY, R. L. N78-21301
BERUBE, J. L. N78-21346
N78-21347
BEST, R. N78-21136
BETHUNE, D. S. N78-21907
BETTS, J. T. N78-21811
BHISALBUTRA, S. N78-21871
BIBRING, H. N78-21139
BIESIADNY, T. J. N78-21112
BIGGERS, J. C. N78-21159
BILL, R. C. N78-21269
BILLINGS, G. N78-21558
BIPPES, H. N78-21412
BISHOP, D. D. N78-21743
BLACK, L. W. N78-21434
BLAHA, M. N78-21924
BLANC, R. P. N78-21819
BLANCHARD, B. J. N78-21339
BLASCHKE, G. N78-21078
BLINMAN, L. N78-21474
BLODGETT, J. A. N78-21433
BLOOMSTER, C. H. N78-21649
BLUMKE, R. E. N78-21223
BOBO, K. N78-21388
BODNER, S. N78-21451
BODNER, S. R. N78-21502
BODZIOCH, K. N78-21356
BOEHM, M. N78-21079
BOGDONOFF, S. M. N78-21420
BOHANNON, G. A. N78-21100
BOHN, C. G. N78-21553
BOLES, M. A. N78-21114
BOLEY, B. A. N78-21962
BOLSHAGIN, V. I. N78-21117
BONK, J. N78-21392
BOPE, J. D. N78-21836
BORILE, F. N78-21140
BORN, G. J. N78-21161
BORNSTEIN, N. S. N78-21268
BOSTIAN, C. W. N78-21336
BOT, Y. L. N78-21124
BOTT, J. F. N78-21242
BOTTRELL, M. S. N78-21471
BOULDRY, J. F. N78-21386
BOURDEAU, R. G. N78-21270
BOUVER, H. N78-21874
BOWDEN, L. W. N78-21520
BOWERS, R. C. N78-21380
BOWERS, R. L. N78-21182
BOX, G. E. P. N78-21860
BOYD, D. M. N78-21476
BOYNTON, W. R. N78-21543
BRACHMAN, R. J. N78-21810
BRADLEY, D. J. N78-21283
BRANDON, C. A. N78-21767
BRATT, P. R. N78-22000
BRAUN, H. I. N78-21852
BRENTNALL, B. N78-21086
BRESLIN, P. J. N78-21703
BRINDLE, D. N78-21646
BRODIE, P. M. N78-21073
BROKOF, U. N78-21087
BROMLEY, K. N78-21911
BROOME, L. E. N78-21167
N78-21171
BROWER, R. F. N78-21244
BROWN, A. N78-21150
BROWN, D. R. N78-21841
BROWN, K. R. N78-21075
BROWN, M. N78-21875
BROWN, R. N78-21661
BROWN, W. E., JR. N78-21566
BRUCKER, C. F. N78-21955
BRUCKNER, J. M. H. N78-21083
BRUN, B. N78-21554
BRUPBACHER, J. M. N78-21310
BRYANT, N. N78-21565
BUBENIK, D. M. N78-21354
BUCHHOLTZ, L. J. N78-21954
BUCKLEY, D. H. N78-21294
N78-21295
BUDENHOLZER, F. E. N78-21898
BUDGOR, A. B. N78-21867
BUISSON, D. N78-21074
BUISSON, M. N78-21134
BULLARD, J. B. N78-21131
BULLOCK, B. L. N78-21352
BULUSU, S. N78-21306
BUNK, E. W. N78-21335
BURK, D. O. N78-21165
BURNETT, R. A. N78-21671
BURNETT, T. A. N78-21670
BURR, W. E. N78-21773
N78-21779
N78-21781
N78-21782
BUSH, H. G. N78-21489
BUTLER, T. A. N78-21201
BUTURLA, E. N78-21758
BUTWELL, R. J. N78-21377
BYERS, D. C. N78-21206

C

CALDER, C. A. N78-21285
CALVERT, S. N78-21682
CAMBRIDGE, J. N78-21646
CAMPBELL, A. G. N78-21965

CANNON, P. J. N78-21565
CANTOR, D. M. N78-21228
CANTOR, S. N78-21218
CAPRILI, M. N78-21157
CARLON, H. R. N78-21914
CARROLL, T. O. N78-21634
CASAD, T. A. N78-21601
CASE, B. N78-21068
CASPI, S. N78-21406
CASS, R. W. N78-21667
CASSANOVA, R. A. N78-21244
CASSIDY, J. E. N78-21105
CASTELAN, W. B. N78-21859
CATALANO, A. W. N78-21646
CAUDILL, S. P. N78-21832
CAVALLOTTI, D. N78-21140
CAVANAUGH, E. C. N78-21325
CAVENY, L. H. N78-21308
CHAKRABARTI, A. K. N78-21985
CHAMBLESS, D. A. N78-21167
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CHAMIS, C. C. N78-21220
N78-21221
CHAN, R. N78-21356
CHAN, T. C. N78-21477
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CHANG, K. S. N78-21250
CHANG, S. K. N78-21349
CHANTOUS, I. M. N78-21128
CHAPLIN, H. R. N78-21060
CHARPENEL, M. N78-21151
CHASE, W. R. N78-21067
CHATURVEDI, P. K. N78-21698
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CHERNOFF, R. C. N78-21333
CHEVALIER, P. A. N78-21755
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N78-21566
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CHOSID, L. N78-21868
CHOUDHURY, B. J. N78-21690
CHRISTE, K. O. N78-21238
CHRISTENSEN, M. N78-21623
N78-21635
CHRISTIANSON, M. N78-21654
CHU, K. R. N78-21375
CIGNOLI, F. N78-21153
CITICI, A. N78-21128
CLAASSEN, J. H. N78-21963
CLARK, J. I. N78-21165
CLARK, R. M. N78-21992
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CLARK, S. K. N78-21326
CLARKE, A. M. N78-21462
CLEARWATERS, A. N78-21775
N78-21777
CLEMENT, D. M. N78-21376
CLIFFORD, W. C. N78-21158
CLINARD, G. I. N78-21668
CLINARD, L. N78-21607
CODISPOTI, L. A. N78-21743
COFER, R. H., JR. N78-21825
COFFEY, H. E. N78-22014
N78-22015
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COLEMAN, A. H. N78-21776
N78-21781
N78-21782
COLESTOCK, P. L. N78-21935
COLLINS, F. G. N78-21167
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COLLINS, N. N78-21607
COLLONS, R. D. N78-21985
COLSON, W. B. N78-21437
COLTON, G. W. N78-21174
COLWELL, J. E. N78-21524
COLWELL, R. N. N78-21520
CONG, H. I. L. N78-21997
CONNOR, R. J. N78-21792
CONRAD, T. N78-21778
COOK, M. M. N78-21272
COOK, T. S. N78-21225
COOPER, D. W. N78-21667
CORBIN, J. H. N78-21704
CORNYN, J. J. N78-21776
CORRELL, D. L. N78-21544
COSAD, C. D. N78-21420
COSDEN, T. H. N78-21452
COUTSOURADIS, D. N78-21142
COX, N. D. N78-21642
CRAIG, J. I. N78-21304
CRAIG, P. N78-21623
CRANE, G. N78-21712
CRESSY, P. J. N78-21529
N78-21558
CRISWELL, D. R. N78-21180
CROSBIE, G. M. N78-21259
CROW, T. T. N78-21360
CRUICKSHANK, C. M. N78-21708
CRUM, F. N78-21066
CSOM, V. N78-21425
CUDLIN, J. J. N78-21478
CULLEY, M. N78-21054
CULP, D. H. N78-21188
CUNNINGHAM, J. R. N78-21167
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N78-21452
CURCIO, J. A. N78-21312
CURL, H., JR. N78-21567
CUTRONA, L. J.

D

DALAL, V. N78-21646
DALTON, V. N78-21646
DANA, R. W. N78-21522
DANCER, A. N78-21749
DANDL, R. A. N78-21935
DANIEL, J. W. N78-21858
DANIEL, L. O. N78-21969
DANIEL, M. R. N78-21282
DANIELS, L. C. N78-21149
DANIKAS, G. I. N78-21827
DANTIN, Y. N78-21184
DANTZIG, G. B. N78-21806
DAPKUS, P. D. N78-21965
DARTER, M. I. N78-21170
DASGUPTA, S. N78-21877
DATTA, B. N78-22004
DAVIN, A. N78-21142
DAVIS, H. L. N78-21966
DAVIS, J. N78-21164
N78-21924
DAVIS, P. N78-21975
DAWSON, A. G. N78-21655
DAWSON, J. M. N78-21927
DE, G. S. N78-21953
DEB, R. K. N78-21824
DECHAIR, R. N78-21158
DECOSTE, R. N78-21446
N78-21451
DEGUEST, P. N78-21124
DELLWIG, L. F. N78-21566
DEMETRIADES, A. N78-21415
DEMMY, W. S. N78-21808
N78-21809
DEMORAIS, P. R. N78-21772
DEMORE, W. B. N78-21664
DENNIS, R. N78-21667
DEROIDE, B. N78-21134
DESILVA, A. W. N78-21453
DESTEIGUER, D. N78-21768
DEVASIRVATHAM, D. M. J. N78-21337
DEVICARIIS, R. N78-21445
DEY, A. N78-21710
DICK, G. M. N78-21167
N78-21171
DIETRICH, D. A. N78-21108
DIGGES, T. G., JR. N78-21600
DIGUMARTHI, R. V. N78-21115
DIMITRIADES, B. N78-21679
DINI, D. N78-21137
DIPRIMA, R. C. N78-21414
DODGE, R. N. N78-21326
DODSON-PRINCE, H. W. N78-22013
DOEBLER, R. E. N78-21622
DOLAN, T. J. N78-21928
DOLAND, G. D. N78-21338
DOLGOPOLOV, G. N78-21185
DOLLING, D. S. N78-21420
DOMINO, E. J. N78-21188
DONAHUE, C. N78-21065
DOUGHERTY, J. J., III N78-21093
DOUGLASS, R. W. N78-21531
DOWLING, J. A. N78-21452
DOWNING, R. G. N78-21601
DOYLE, F. J. N78-21174
DOYON, L. R. N78-21099
DRAFALL, L. N78-21454
DRAPER, C. W. N78-21956
DRAPIER, J. M. N78-21142
DRESNER, L. N78-21967
DROBOT, A. T. N78-21375
DRUBKA, R. E. N78-21432
DRYER, F. L. N78-21245
N78-21311
DUCATI, U. N78-21140
DUCROS, R. N78-21246
DUE, H. F. N78-21123
DUNCAN, T. E. N78-21829
DUNN, R. B. N78-21999
DUPUIS, R. D. N78-21965
DURENBERGER, D. W. N78-21889
DYAKONOV, V. S. N78-21117
DYDYNSKI, M. N78-21788
DYER, C. R. N78-21800

E

EAGLE, C. D. N78-21471
EANES, R. S. N78-21340
N78-21341
EASTERLING, A. E. N78-21123
EASTON, R. L., JR. N78-21433
EBBESEN, L. R. N78-21396
ECKERT, H. U. N78-21233
EDDY, A. N78-21709
EDGERTON, A. T. N78-21572
EDWARDS, W. T. N78-21098
EGGEBRECHT, R. N78-21119
N78-21125
EGGLETON, R. E. N78-21174
EGRICAN, A. N. N78-21587
EHN, G. N78-21062
EISENBERG, M. N78-21550
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EISWERTH, J. E. N78-21147
EKELCHIK, V. S. N78-21291
EL-BAZ, F. N78-21174
ELACHI, C. N78-21565
ELLINGSON, W. A. N78-21916
ELLIOTT, R. D. N78-21731
ENDRES, A. C. N78-21481
ENFIELD, C. G. N78-21436
ENSOR, D. S. N78-21680
EPSTEIN, S. N78-21974
ERDOS, J. I. N78-21213
ERNST, B. F. N78-21077
ERNST, R. C. N78-21138
ESARY, J. D. N78-21482
ESKESEN, J. H. N78-21651
ESTELL, R. N78-21778
ESTES, J. E. N78-21520
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ETHRIDGE, C. D. N78-21789
ETHRIDGE, G. A. N78-21701
EVANICH, P. L. N78-21110
EVANS, D. N78-21599
EVANS, R. M. N78-21677
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EVRARD, G. N78-21749

F

FAGEN, E. A. N78-21646
FAIN, J. N78-21975
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FARRAR, N. R. N78-21297
FASSBENDER, L. L. N78-21649
FAUCETT, H. L. N78-21670
FAUGHT, W. S., III N78-21790
FEFELOV, N. N78-21762
FEIN, E. N78-21065
FELIX, L. G. N78-21668
FEMENIAS, J. L. N78-21900
FENTON, D. L. N78-21665
FEOKTISTOV, K. N78-21185
FERBER, R. N78-21599
FERNSLER, R. F. N78-21453
FERRELL, J. E. N78-21677
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FEWELL, L. L. N78-21214
FEYERHERM, A. M. N78-21515
FICHTL, G. H. N78-21198
FIELDS, J. N., III N78-21938
FIGLIN, S. Z. N78-21280
FILHO, R. A. N78-21510
FINGER, R. W. N78-21493
N78-21494
FINNEGAN, J. P. N78-21764
FIORENTINO, A. J. N78-21111
FISHER, G. B. N78-21239
FLAHERTY, J. E. N78-21414
FLEMING, W. S. N78-21657
FORBES, C. N78-21457
FOX, C. H., JR. N78-21049
FRALEY, D. W. N78-21671
FRANCIS, P. H. N78-21277
FRANCISCO, S. N78-21567
FRANCOIS, J. N78-21124
FRANKE, R. N78-21749
FRANKLIN, J. C. N78-21283
FRASER-SMITH, A. C. N78-21354
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FRECHE, J. C. N78-21122
N78-21266
FREDEN, S. C. N78-21540
FREDERKING, T. H. K. N78-21406
FREED, A. N78-21186
FREEMAN, E. N78-21344
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FRENCH, R. G. N78-22005
FRENKEL, A. L. N78-21932
FREY, H. V. N78-21685
FRIEBERTSHAUSER, M. A. N78-21743
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FRIESE, L. V. N78-21722
FRISCH, H. P. N78-21200
FRITZ, R. B. N78-21711

FROMME, J. N78-21059
FRYMOYER, J. W. N78-21758
FRYMOYER, W. W. N78-21758
FU, K. S. N78-21784
FUGATE, K. O. N78-21387
FULFORD, J. N. N78-21725
FULLER, D. B. N78-21538
FULLER, K. B. N78-21538
FULLER, S. H. N78-21773
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FURSEY, A. N78-21287

G

GADDIS, J. L. N78-21767
GADDY, O. L. N78-21905
GAILLAC, J. P. N78-21134
GALASI, A. A. N78-21496
GALIBERT, G. N78-21571
GALMICHE, P. N78-21141
GAMBUCCI, B. J. N78-21094
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GARBER, J. M. N78-21536
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GARDNER, C. S. N78-21444
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GARRETT, S. E. N78-21150
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GATLEY, I. N78-21996
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GAUSMAN, H. W. N78-21509
GAVALER, J. R. N78-21282
GAYNOR, T. L. N78-21471
GEBALLE, T. H. N78-21959
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GEIS, J. W. N78-21744
GENYS, J. B. N78-21554
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GEORGI, D. T. N78-21735
GEOSLING, C. N78-21243
GERACI, M. J. N78-21429
GERCHIKOV, A. B. N78-21280
GERHARDSTEIN, A. C. N78-21251
GERSHON, I. J. N78-21143
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GESEK, W. N78-21356
GHEZZI, U. N78-21153
GIARDINA, C. R. N78-21073
GIFFORD, M. D. N78-21724
GILBERT, E. G. N78-21162
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GILBERT, R. N78-21564
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GILYARD, G. B. N78-21160
GLADDEN, J. W. N78-21577
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GODSHALL, F. A. N78-21506
GOETZ, A. N78-21565
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GOLBERG, M. N78-21059
GOLDBERG, M. N78-21846
GOLDFINCH, A. L. N78-21477
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GOLDRING, T. N78-21885
GOODENOUGH, J. B. N78-21340
N78-21341
GOODMAN, A. W. N78-21614
GOODRICH, D. N78-21065
GOPHER, D. N78-21765
GORDON, H. H. N78-21560
GORDON, J. T., JR. N78-21464
GORDON, R. N78-21774
N78-21777
GOTTLIEB, G. N78-21879
GRANATSTEIN, V. L. N78-21375
GRANHOLM, E. N78-21402
GRAY, S. N78-21472
GREEN, I. M. N78-21795
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GREIG, J. R. N78-21453
GRENCH, A. W. N78-21346
GRIBBIN, F. N78-21646
GRIER, E. S. N78-21656
GRIER, N. N78-21373
GRIFFIN, R. H., II N78-21568
GRIFFITH, W. M. N78-21272
GRIGGS, D. B. N78-21182
GROLIER, M. J. N78-21174
GRUBER, R. P. N78-21203
GUMAN, W. N78-21355
GURNEY, R. D. N78-21382
GUTH, G. F. N78-21378
GUTIERREZ, A. N78-21243
GUTKOWICZ-KRUSIN, D. N78-21894
GUTTMAN, A. N78-21452
GYENES, G. N78-21425

H

HAAS, J. E. N78-21123
HABRAKEN, L. N78-21142
HACKETT, C. E. N78-21463
HAIR, L. M. N78-21210
HALEY, F. A. N78-21188
HALFORD, G. R. N78-21267
HALL, B. S. S. N78-21229
HALL, R. B. N78-21646
HALL, R. R. N78-21667
HALLBACH, P. N78-21674
N78-21675
HALSEY, N. D. N78-21047
HAM, W. T., JR. N78-21462
HAMM, J. R. N78-21939
HAMPEL, V. E. N78-21986
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HAN, L. S. N78-21130
HANNAN, P. J. N78-21748
HANNI, R. S. N78-22003
HANSEN, F. V. N78-21701
HANSON, E. G. N78-21937
HAPPER, W. N78-21236
HARLAN, J. C. N78-21564
HARMAN, D. M. N78-21538
HARRIS, S. E. N78-21450
HARRISON, R. E. N78-21567
HARVEY, G. L. N78-21697
HASPERT, K. N78-21066
HAUER, A. N78-21888
HAUTALA, R. R. N78-21626
N78-21627
N78-21628
N78-21629
HAYES, J. N78-21975
HAYES, K. C., JR. N78-21799
HAYNES, L. N78-21778
HAZELWOOD, L. A. N78-21975
HEAD, J. W., III N78-21174
HEALEY, J. N78-21618
HEDEMAN, E. R. N78-22013
HEDGLEY, D. R. N78-21839
HEDRICK, R. A. N78-21422
HEIGHWAY, J. E. N78-21566
HEILMAN, J. N78-21516
HEIMBIGNER, D. M. N78-21796
HEISE, G. C. N78-21729
HEIST, D. N78-21356
HELLER, W. G. N78-21706
HELMINK, R. C. N78-21253
HENNECKE, D. K. N78-21125
HEPNER, T. P. N78-21410
HERMAN, M. N78-21799
N78-21823
HESS, J. N78-21847
N78-21848
HEUMANN, J. M. N78-21725
HEUSER, J. S. N78-21567
HEWLETT, H. W. N78-21166
HEYWOOD, J. B. N78-21116
HICKERNELL, F. N78-21385
HICKEY, P. J. N78-21166
HICKMAN, G. D. N78-21526
N78-21549
N78-21557
HICKS, K. W. N78-21573
HICKS, R. E. N78-21116
HILL, J. M. N78-21556
HILLIER, F. S. N78-21804
HINGST, W. R. N78-21404
HIPOLITO, O. N78-21964
HISE, E. C. N78-21647
HO, J. K. N78-21798
HOAD, D. R. N78-21410
HOCKEY, B. J. N78-21296
HODGE, L. G. N78-21182
HODGES, C. A. N78-21174
HOFFER, E. M. N78-21248
HOFFER, R. N78-21564
HOFFMAN, D. N78-21741
HOFFMAN, J. B. N78-21101
HOGGE, M. N78-21144
HOLCOMBE, C. E. N78-21217
HOLLAND, C. J. N78-21851
HOLLAND, M. J. N78-21120
HOLLAND, R. L. N78-21198
HOLLANDS, K. G. T. N78-21624
HOLLINGER, J. P. N78-21738
HOLLIS, H. D. N78-21615
HOLMES, J. A. N78-21816
HOLMES, N. C. N78-21455
HOMER, M. L. N78-21543
HOOPER, F. C. N78-21625
HOOPER, R. G. N78-21645
HOOS, I. R. N78-21680
HOOVER, J. W. N78-21520
HOPKINS, C. O. N78-21503
HOPKINSON, J. F. N78-21771
HORN, R. M. N78-21940
HORNE, J. M. N78-21254
HORNFECK, W. A. N78-21941
N78-21167
HOSTETLER, L. D. N78-21171
HOVIS, W. A. N78-21070
HOVIS, W. G. N78-21541
HOWARD, K. A. N78-21557
HOWBRIGG, R. N78-21174
HSIA, J. C. N78-21774
HSIEH, B. J. N78-21456
HSIEH, C. K. N78-21505
HUACO, D. N78-21916
HUANG, H. N78-21687
HUANG, N. E. N78-21497
HUBBARTT, J. E. N78-21737
HUDSON, H. S. N78-21241
HUFFMAN, J. K. N78-22016
HUGGETT, C. N78-21049
HUMPHRIES, W. R. N78-21234
HUNT, R. F. N78-21605
HURFORD, G. N78-21555
HURRAS, K. N78-22016
HUVAL, D. J. N78-21088
N78-21241

I

ICHIKAWA, M. N78-21331
IGNACZAK, L. R. N78-21188
IKEGAMI, H. N78-21935
ILIN, A. V. N78-21390
INFANTE, E. F. N78-21859
IPPOLITO, J. C. N78-21212
IRVOAS, J. N78-21074
IRWIN, A. T. N78-21776
ISMAILOV, V. S. N78-21291
ISOGAI, K. N78-21055
IURKOV, E. F. N78-21843
IVIE, C. N78-21173
IYENGAR, S. K. R. N78-21395

J

JACKSON, R. D. N78-21518
JACOB, J. H. N78-21456
JACOBS, F. A. N78-21492
JACOBS, V. L. N78-21924
JAFFE, L. D. N78-21173
JAFFEE, R. L. N78-21215
JAGUSZTYN, T. N78-21657
JAMES, C. E. N78-21535
JAMES, H. G. N78-21334
JANSEN, F. N78-21252
JARMAN, J. W. N78-21558
JARRELL, D. W. N78-21985
JARVIS, J. L. N78-21417
JATKAR, A. D. N78-21258
JELLINEK, E. N78-21068
JENSEN, C. L. N78-21792
JENSEN, W. P. N78-21642
JODY, B. J. N78-21399
JOHNSON, H. N78-21296
JOHNSON, J. C. N78-21769
JOHNSON, R. E. N78-21965
JOHNSON, R. W. N78-21553
N78-21983
JOHNSON, W. B. N78-21672
JOHNSON, W. F. N78-21739
JOLLY, S. T. N78-21961
JONES, J. E. N78-21483
JONES, P. L. N78-21255
JONES, T. V. N78-21149
JONES, W. P. N78-21158
JONES, W. R., JR. N78-21470
JONKERS, H. L. N78-21084
JOOSTEN, R. N78-21566
JORDAN, R. L. N78-21567
JOSEPH, D. W. N78-21707
JOSEPH, T. W. N78-21579
JOYCE, A. T. N78-21568
JUSTUS, J. N78-21567

K

KAGIWADA, H. N78-21848
KAHLE, A. B. N78-21523
N78-21569
KAI, T. N78-21161
KAIL, K. A., IV N78-21061
KAJFEZ, D. N78-21359
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N78-21848
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KALTER, R. J. N78-21990
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KAPPEL, M. W. N78-21837
KAPPETIJN, F. K. N78-21084
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KARIM, D. P. N78-21942
KARPOVA, N. I. N78-21172
KATAHARA, K. W. N78-21943
KAUFFMAN, S. R. N78-21336
KAZANTSEVA, V. V. N78-21290
KEALOHA, J. H. S. N78-21673
KEE, J. L. N78-21744
KEEFER, D. K. N78-21684
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N78-21341
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KERSLAKE, W. R. N78-21202
KESSLER, E. N78-21730
KEZERLE, J. A. N78-21302
KHORRAM, S. N78-21520
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KIM, Y. I. N78-21406
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KISCH, D. N78-21232
KLEE, V. N78-21797
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N78-21341
KNAPP, S. C. N78-21769
KNIGHT, R. M. N78-21209
KNIGHT, R. W. N78-21733
KNOLL, M. G. N78-21388
KNOWLES, J. K. N78-21501
KOBAYASHI, A. S. N78-21504
KODALI, S. P. N78-21261
KODITSCHEK, D. E. N78-21865
KOEHLER, H. N78-21125
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KOHN, W. N78-21964
KOMINE, H. N78-21459
KONCEN, R. E. N78-21433
KOOPMAN, D. W. N78-21453
KOSLIN, M. E. N78-21431
KOSOFSKY, L. J. N78-21174
KOSTRITSKII, S. N. N78-21291
KOTHNY, E. L. N78-21248
KOUALSKI, S. N78-21066
KOUVOUMJIAN, J. N78-21707
KOVACH, C. W. N78-21265
KOVACH, L. N78-21217
KOZLOV, L. F. N78-21411
KRAFT, C. C., JR. N78-21612
KRAM, W. N78-21068
KRECKER, D. K. N78-21831
KREGER, A. F. N78-21222
N78-21293
KRENZ, H. G. N78-21288
KRIAL, N. N78-21457
KRIER, H. N78-21302
KRISHEN, K. N78-21565
KRISHNAMURTHY, E. V. N78-21845
KRUSE, H. N78-21127
KRYCUK, G. A. N78-21431
KRYTER, R. C. N78-21483
KUEBERT, E. J. N78-21525
KUEHL, W. N78-21126
KUHLMAN, J. M. N78-21096
KUKIELKA, C. A. N78-21615
KULKARNI, S. V. N78-21219
KUO, S. P. N78-21925
KURTZ, D. N78-21057
KUSENBERGER, F. N. N78-21277
KUTAL, C. R. N78-21626
N78-21627
N78-21628
N78-21629
KUTATELADZE, S. S. N78-21408
N78-21409
KWON, W. H. N78-21822
N78-21883
N78-21884

L

LACEY, G. E. N78-21668
LACOSS, R. T. N78-21576
LAGARDE, X. N78-21074
LAGER, D. L. N78-21368
LAI, T. L. N78-21864
LAING, W. R. N78-21283
LAMB, D. A. N78-21773
LAMBIOTTE, J. J. N78-21050
LAMONTAGNE, R. A. N78-21748
LANE, G. N78-21364
LANKFORD, J. N78-21277
LARK, R. F. N78-21221
LARMAN, D. N78-21797
LARSON, R. S. N78-21058
LASCOE, O. D. N78-21475
LAU, K. H. N78-21944
LAUGHLIN, A. W. N78-21709
LAURIE, V. J. N78-21526
LAUVER, M. R. N78-21922
LAW, D. A.
LAWNCZECK, O.
LAWRENCE, R. S.
LAYDEN, G. K.
LAZZERETTI, R.
LEAMER, R. W.
LEAR, D. W., JR.
LEBOT, Y.
LECHNER, W.
LECISCOCCIA, G.
LEE, D.
LEE, G. F.
LEE, H. W.
LEE, J.
LEE, J. Y.
LEE, T. W.
LEE, W. W.
LEGOFF, P.
LEGRIVES, E.
LEHMAN, T. H.
LEHMBERG, R.
LEIKACH, K. I.
LEIPOLD, M. H.
LEITAO, C. D.
LEITNAKER, J. M.
LEONOVA, S. I.
LERDAL, D. A.
LESTINGI, J.
LEVINSEN, M.
LEVSHINOVA, Z. V.
LEVY, R.
LEWIS, A. J.
LEWIS, B. C.
LEWIS, J. C.
LEWIS, N. N.
LIANG, W. J.
LIAO, W. H.
LIEBERT, B. E.
LIEBERT, J. W.
LIEBLEIN, E.
LINDSEY, G. H.
LINLOR, W.
LINTERN, G.
LIPES, R.
LIU, T. K.
LJUNG, G. M.
LLORET, P.
LOBANOV, Y. M.
LOCKWOOD, V. E.
LOGAN, D. L.
LOMBARDO, S.
LONG, L. E.
LORENTS, D. C.
LOSCH, K.
LOUER, J. W.
LOUIS, J. F.
LOVOV, C. V.
LOWENGRUB, M.
LOWREY, B. E.
LOWRY, M. J.
LOZANO H., A. E.
LUBOW, S. H.
LUCHINI, J. R.
LUDWIG, F. L.
LUDWIG, L. P.
LUERS, J. K.
LUIDENS, R. W.
LUMSDEN, J. B.
LUND, R. A.
LUNDIEN, J. R.
LYNCH, S. J.

M

MABRY, J. E.
MACDONALD, H. C.
MACGREGOR, D. M.
MACLEOD, N. H.
MADEY, T. E.
MADNICK, S. E.
MADURA, D. P.
MAHAJAN, R. L.
MAHER, P. A.
MAHONEY, J. F.
MAINEMER, C. I.
MALL, S.
MANASEVIT, H. M.
MANATT, S. A.
MANCUSO, R. L.
MANDELL, M. J.
MANGANO, J. A.
MANGIARACINA, L.
MANHEIMER, W. M.
MANI, S. A.
MANISTA, E. J.
MANJOINE, M. J.
MANLEY, J.
MANNA, Z.
MANNING, B.
MANSOUR, M. N.
MANTENIEKS, M. A.
MANUS, E. A. N78-21336
MARDESICH, N. N78-21600
MARINKAS, P. L. N78-21306
MARISKA, J. T. N78-22011
MARLAND, G. N78-21652
MARMELSTEIN, A. N78-21565
MARSCHNER, B. N78-21171
MARSCHNER, B. W. N78-21167
MARSHALL, R. E. N78-21336
MARTIN, B. G. N78-21946
MARTIN, B. W. N78-21150
MARTINI, W. R. N78-21590
MARTORANO, L. N78-21137
MARVIN, J. G. N78-21407
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MASTIN, C. W. N78-21840
MASUNG, L. L. S. N78-22010
MASURSKY, H. N78-21174
MASZATICS, J. N78-21402
MATHIAS, C. M., JR. N78-21527
MATHUR, A. K. N78-21622
MATTERI, R. N78-21758
MATTHEWS, J. B. N78-21072
MATTHEWS, R. E. N78-21562
MATZKANIN, G. A. N78-21277
MAXWELL, A. N78-22012
MAXWELL, J. D. N78-21670
MAYBECK, P. S. N78-21854
MAZANKINE, J. N78-21212
MAZUR, V. A. N78-21932
MCCABE, M. W. N78-21850
MCCAIN, J. D. N78-21668
MCCALL, M. T. N78-21310
MCCLOUD, J. L., III N78-21159
MCCOLGAN, C. J. N78-21058
MCCONVILLE, R. P. N78-21893
MCCORMICK, J. N78-21472
MCCORMICK, S. N78-21786
MCCRACKEN, D. N78-21785
MCDONALD, C. L. N78-21649
MCDONEL, J. D. N78-21147
MCDOWELL, R. S. N78-21917
MCEDWARDS, D. G. N78-21631
MCFADDEN, E. B. N78-21768
MCFADDEN, J. N78-21669
MCFALL, J., JR. N78-21555
MCGAVIN, R. E. N78-21106
MCGILL, R. N78-21451
MCGLASSON, A. J. N78-21721
MCGUIRE, C. B. N78-21623
N78-21635
MCGUIRK, M. N78-21910
MCHALE, E. T. N78-21309
MCILROY, J. N78-21975
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MCLAUGHLIN, R. W. N78-21897
MCMAHON, J. N78-21451
MCMANUS, B. L. N78-21163
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MCMENAMIN, J. J., JR. N78-21045
MCNAMARA, B. N78-21936
MCNEELY, D. R. N78-21949
MEAKIN, J. D. N78-21646
MEDGYESI-MITSCHANG, L. N. N78-21358
MEDVEDEVA, M. A. N78-21117
MEGER, R. A. N78-21920
MEHRABIAN, R. N78-21279
MENDELSOHN, L. B. N78-21960
METZGER, M. N78-21274
MEYERS, J. F. N78-21410
MIAO, W. N78-21098
MICHARD, J. N78-21124
MICHARD, P. J. N78-21151
MIHURSKY, J. A. N78-21543
MIKASA, M. N78-21445
MIKHAILOVSKII, A. B. N78-21931
N78-21890 N78-21932
N78-21565 N78-21933
N78-21391 N78-21934
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MIKUS, T. N78-21823
MILGRAM, D. L. N78-21564
MILLER, J. M. N78-21565
MILLER, L. J. N78-21547
MILLER, M. H. N78-21554
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MILLER, R. G. N78-21155
MILLIGAN, R. W. N78-21697
MILTON, A. F. N78-21361
MITTRA, R. N78-21294
MIYOSHI, K. N78-21295
N78-21331
MIZOGUCHI, A. N78-22013
MOHLER, O. C. N78-21928
MOIR, R. W. N78-21682
MONAHAN, G. M. N78-21570
MONGET, J. M. N78-21332
MONTEATH, G. D. N78-21169
MONTEMERLO, M. D. N78-21555
MOON, M. L. N78-21516
MOORE, D. G. N78-21981
MORAWSKI, P. E. N78-21224
MORRIS, D. H. N78-21156
MORRIS, W. D. N78-21131
MORRIS, W. H. N78-21345
MOSES, H.

MOUDY, L. A. N78-21965
MOYERS, J. C. N78-21647
MROCZYNSKI, R. P. N78-21519
MUDHOLKAR, G. S. N78-21876
MUELLER, H. A. N78-21462
MUGLER, J. P., JR. N78-21557
MUIRHEAD, V. U. N78-21889
MULDREW, D. B. N78-21334
MULVEY, G. J. N78-21715
MUNDAY, J. C., JR. N78-21560
MURAD, E. N78-21700
MURAKAMI, M. N78-21193
MURPHY, R., JR. N78-21138
MUSEN, P. N78-21691
MUSICK, J. K. N78-21237

N

NABEL, E. N78-21484
NACHTIGALL, A. J. N78-21267
NAGEL, D. N78-21451
NAKAGAWA, Y. N78-21802
NAKANISHI, S. N78-21207
NAMER, I. N78-21636
NAMKEN, L. N. N78-21509
NAPIER, J. C. N78-21423
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NARENDRA, K. S. N78-21865
NASCIMENTO, F. S. D. N78-21514
NASCIMENTO, M. A. L. S. D. N78-21514
NATHANS, R. N78-21634
NAZARETH, L. N78-21817
NEALE, D. H. N78-21241
NEKORYAKOV, V. E. N78-21408
NETZER, D. W. N78-21166
NETZORG, G. B. N78-21892
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NEUMANN, C. P. N78-21424
NEWELL, A. N78-21783
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NIELSEN, L. C. N78-21376
NIXON, P. R. N78-21509
NORTON, H. N. N78-21173
NOVAK, S. R. N78-21256
NOVOGRODSKY, A. N78-21753
NYPAN, L. J. N78-21469

O

OBRIEN, D. M. N78-21869
OCTAVIO, M. N78-21381
ODERMATT, R. N78-21958
ODONNELL, K. N78-21312
OKEKE, C. E. N78-21950
OKUDA, H. N78-21930
OLDFIELD, M. L. G. N78-21149
OLIVER, E. N78-21849
OLKHOVENKO, V. P. N78-21172
OLSON, D. N78-21385
OMALLEY, M. J. N78-21841
OPPENHEIMER, M. N78-21065
ORAVA, R. N. N78-21278
ORLANSKY, J. N78-21168
ORLOFF, J. H. N78-21909
OSSAKOW, S. L. N78-21698
OSTROFSKY, B. N78-21973
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OVERSTREET, W. P. N78-21336
OWEN, J. M. N78-21133

P

PACKARD, T. T. N78-21745
PADDON, E. A. N78-21442
N78-21443
PAICE, D. A. N78-21392
PAKIN, V. N. N78-21390
PALEMEDO, P. F. N78-21634
PALEY, H. N. N78-21523
PALMEDO, P. F. N78-21633
PANOFSKY, H. A. N78-21712
PANOV, A. P. N78-21390
PAPADALES, B. S., JR. N78-21060
PAPPERT, R. A. N78-21702
PARADELLA, W. R. N78-21510
PARFENOV, G. P. N78-21172
PARIKH, S. C. N78-21806
PARK, A. B. N78-21553
PARKER, R. J. N78-21470
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PARKER, T. E. N78-21374
PARKINSON, B. W. N78-21085
PARKMAN, P. N78-21657
PARRA, C. G. N78-21737
PARSONS, J. N78-21564
PATCH, R. W. N78-21596
PATOUILLET, C. N78-21748
PATRICK, R. L. N78-21819
PATRUSKY, B. N78-21356
PAULSON, R. E. N78-21792
PEARSON, A. E. N78-21821
N78-21822
N78-21882
N78-21883
N78-21884
PEARSON, A. O. N78-21557
PECHACEK, R. E. N78-21453
PELEG, S. N78-21801
PEMBERTON, D. A. N78-21526
N78-21536
PERINI, J. M. N78-21345
PEROLD, A. F. N78-21805
PERRY, A. M. N78-21652
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PETERS, B. C. N78-21320
PETERSON, L. E. N78-22016
PETKAU, A. J. N78-21194
N78-21856
N78-21878
PETRINO, E. A. N78-21138
PETROV, B. N78-21176
PETTIS, R. W. N78-21747
PEUKER, G. N78-21078
PFAFF, K. N78-21125
PHILLIP, A. T. N78-21747
PHILLIPS, M. A. N78-21196
PHILLIPS, S. L. N78-21622
PICHUGOV, M. Y. N78-21172
PICKEL, F. E. N78-21082
PIJANOWSKI, J. A. N78-21542
N78-21555
PINCKNEY, S. Z. N78-21107
PINSKI, M. S. N78-21768
PIPES, R. B. N78-21219
PISTEK, P. N78-21686
PITTS, J. I. N78-21050
PLATONOVA, R. N. N78-21172
PLOWDEN, S. P. C. N78-21658
POE, G. G. N78-21677
N78-21678
POGGIO, A. J. N78-21368
POLASEK, J. N78-21048
POLCYN, F. N78-21564
POOL, W. M., JR. N78-21725
POON, S. J. N78-21951
POPE, M. H. N78-21758
POTTER, G. A. N78-21283
POWELL, E. A. N78-21244
POWER, J. C. N78-21204
PRAJOUS, R. N78-21212
PRICE, J. L. N78-21143
PRICE, R. D. N78-21540
N78-21555
PRIDDIN, C. H. N78-21158
PRIEM, R. J. N78-21596
PRONIN, V. A. N78-21231
PURCELL, R. N78-21665
PURVIS, C. K. N78-21373
PUTKOVICH, R. P. N78-21392

Q

QUON, B. H. N78-21935

R

RABINOWICZ, E. N78-21476
RAGAINI, J. D. N78-21249
RAGAN, J. A. N78-21984
RAGAN, R. M. N78-21536
RAITHBY, G. D. N78-21624
RAJ, P. P. K. N78-21666
RAJAPAKSE, Y. D. S. N78-21490
RAMACHANDRA, S. M. N78-21103
RAMATI, S. D. E. N78-21279
RAMESH, N. S. N78-21784
RAMKUMAR, R. L. N78-21219
RANDALL, L. S. N78-21195
RANTANEN, R. O. N78-21197
RANZIERI, A. J. N78-21676
RAO, G. V. R. N78-21115
RAO, M. N78-21719
RAUM, C. E. N78-21349
RAUM, W. E. N78-21556
RAUNER, H. N78-21298
RAWLIN, V. K. N78-21205
RAYMOND, W. H. N78-21688
READY, J. F. N78-21460
REBEL, D. L. N78-21524
REED, L. E. N78-21770
REEVES, F. N78-21189
REITER, E. N78-21672
N78-21673
REVELL, J. D. N78-21095
REVZIN, A. M. N78-21754
RHEA, J. O. N78-21714
RHEE, K. T. N78-21227
RHODES, E. J., JR. N78-22008
RHODES, W. F. N78-21556
RICHARDS, B. E. N78-21152
RICHARDS, P. L. N78-21963
RICHARDSON, A. J. N78-21509
RICHARDSON, A. S. N78-21642
RICHARDSON, D. L. N78-21187
RICHARDSON, D. W. N78-21091
RICKER, C. W. N78-21483
RIPIN, B. H. N78-21446
N78-21451
ROBBEN, R. N78-21636
ROBERTS, E. H. N78-21522
ROBERTS, R. N78-21111
ROBERTSON, G. N78-21785
ROBINSON, A. E., JR. N78-21539
ROCHE, J. C. N78-21372
RODI, W. L. N78-21705
RODRIGUES, J. N78-21775
RODRIGUEZ, J. R. N78-21112
ROGERS, C. N78-21474
ROGERSON, J. E. N78-21924
ROHN, D. A. N78-21269
ROKNI, M. N78-21456
ROLLBUHLER, R. J. N78-21596
ROLLER, N. E. G. N78-21524
ROSCOE, S. N. N78-21756
ROSE, J. R. N78-21791
ROSE, L. A. N78-21094
ROSENFELD, A. N78-21[illegible]
N78-21[illegible]
ROSKAM, J. N78-21889
ROSS, C. A. N78-21503
ROTHFUL, R. R. N78-21424
ROTTY, R. M. N78-21643
ROWE, J. E. N78-21391
RUBIN, A. L. N78-21753
RUBIN, H. N78-21862
RUFFOLO, J. J. N78-21462
RUSCITTO, D. N78-21472
RUSNAK, J. P. N78-21138
RUSSELL, L. M. N78-21113
RUSSELL, P. L. N78-21138
RUTH, R. P. N78-21965
RYZHOV, A. A. N78-21117

S

SABER, A. J. N78-21308
SAFFORD, F. B. N78-21500
SAMARA, G. A. N78-21968
SAMEJIMA, F. N78-21873
SANDER, G. N78-21144
SANDERS, T. H. N78-21163
SANTORO, R. J. N78-21311
SAPP, H. N78-21080
SARPKAYA, T. N78-21416
SARYAL, M. N78-21128
SASOR, S. R. N78-21327
SBOROVSKII, A. K. N78-21291
SCHACK, C. J. N78-21238
SCHANTZ, L. E. N78-21435
SCHARDT, B. B. N78-21564
SCHATZ, J. G., JR. N78-21[illegible]
SCHEFER, R. N78-21[illegible]
SCHENCK, H. N78-21445
SCHIJVE, J. N78-21492
SCHMIDT, A. W. N78-21697
SCHMIDT, F. W. N78-21479
SCHMITENDORF, W. E. N78-21830
SCHNEIBLE, D. N78-22016
SCHOENBERG, I. J. N78-21828
SCHOLZ, N. N78-21413
SCHROEDER, F. W. N78-21683
SCHULTZ, D. L. N78-21149
SCHWARZ, F. C. N78-21384
SCHWARZMEIER, J. L. N78-21918
SCHWARZSCHILD, M. N78-21852
SCHWEGLER, H. F. N78-21089
SCOFIELD, R. A. N78-21732
SEAMAN, G. V. F. N78-21753
SEAMAN, N. L. N78-21716
SEDGWICK, G. N78-21145
SEFTOR, J. L. N78-21375
SEGAL, B. N78-21689
SEIDEL, D. B. N78-21365
N78-21[illegible]66
SEIFERT, C. J. N78-[illegible]887
SELLIN, I. A. N78-21902
SEPRI, P. N78-22007
SHAHIN, M. Y. N78-21170
SHAI, M. C. N78-21216
SHAKER, F. J. N78-21188
SHAMAN, P. S. N78-21773
SHAMIR, A. N78-21866
SHANER, J. W. N78-21285
N78-21286
SHANKAR, S. N78-21257
SHARP, T. E. N78-21461
SHARPE, T. G. N78-21083
SHELTON, E. M. N78-21324
SHEN, L. C. N78-21389

SHEPPARD, T. J. N78-21376
SHIMIZU, A. B. N78-21677
N78-21678
SHINKLE, J. N. N78-21069
SHIPLEY, R. G. N78-21105
SHIRLEY, E. C. N78-21676
SHIVER, W. S. N78-21740
SHOCKEY, L. R. N78-21702
SHOVLIN, M. D. N78-21094
SHUKHMAN, I. G. N78-21932
N78-21934
SHUMAR, J. W. N78-21235
SHUMPERT, T. H. N78-21342
N78-21343
SIDWELL, L. B. N78-21598
SIEGMAN, A. E. N78-21455
SIEGMUND, D. N78-21863
N78-21864
N78-21880
SIERAKOWSKI, R. L. N78-21503
SIEWIOREK, D. N78-21774
N78-21777
SIGMON, T. W. N78-21397
SILVER, R. H. N78-21545
SILVESTROV, G. I. N78-21390
SIMAKHIN, Y. F. N78-21904
SIMMON, P. B. N78-21673
SIMMONS, M. N78-21623
N78-21635
SIMOPOULOS, A. K. N78-21807
SINGH, H. B. N78-21672
SINNOTT, P. R. J. N78-21658
SIVAZLIAN, B. D. N78-21971
SKOKOOH, A. N78-21486
SLAUGHTER, E. R. N78-21270
SLINEY, D. H. N78-21457
SLONIMSKII, G. L. N78-21290
SMALL, L. N78-21746
SMEGGIL, J. G. N78-21268
SMITH, A. N78-21430
SMITH, G. C. N78-21747
SMITH, H. W. N78-21889
SMITH, J. L. N78-21564
SMITH, J. W. N78-21160
SMITH, L. M. N78-21812
SMITH, P. M. N78-21053
SMITH, R. N78-21099
N78-21799
SMITH, R. E. N78-21050
SMITH, W. R. N78-21776
N78-21781
N78-21782
SMITHEY, W. J. H. N78-21060
SMOKLER, P. E. N78-21664
SNIEGOSKI, P. J. N78-21380
SOHA, J. M. N78-21569
SOLOMON, H. N78-21855
SOLTES, A. S. N78-21099
SORVARI, J. M. N78-22001
SOTOVARGAS, C. W. N78-21895
SPENCER, F. A. N78-21092
SPICER, C. W. N78-21707
SPIETH, H. N78-21214
STAEHLE, R. W. N78-21273
STAID, P. S. N78-21044
STAMPER, J. N78-21451
STASKUS, J. V. N78-21199
N78-21373
N78-21173
N78-22017
STEARNS, J. W. N78-21546
STECKER, F. W. N78-21430
STEHLING, K. R. N78-21753
STELL, R. E. N78-21855
STENZEL, K. H. N78-21634
STEPHENS, M. A. N78-21372
STERN, R. N78-21373
STEVENS, N. J. N78-21276
N78-21746
STEVENSON, J. R. N78-21561
STEVENSON, M. N78-21618
STEWART, J. C. N78-21076
STEWART, R. N78-21173
STIELER, B. N78-21419
STIMPSON, L. N78-21114
STINEBRING, D. R. N78-21278
STOCKMAN, N. O. N78-21775
STONE, G. A. N78-21779
STONE, H. N78-21713
N78-21241
STONEMAN, W. C. N78-21304
STRAHLE, W. C. N78-21292
N78-21197
STRAKHOV, V. L. N78-21485
STRANGE, D. A. N78-21974
STRENKOWSKI, J. S. N78-21168
STRIEB, M. N78-21132
STRING, J. N78-21418
STUART-MITCHELL, R. W. N78-21426
STUHMILLER, J. H. N78-21336
STUMP, H. P. N78-21890
STUTZMAN, W. L. N78-21066
SULLIVAN, B. M. N78-21220
SULLIVAN, N. N78-21308
SULLIVAN, T. L. N78-21190
SUMMERFIELD, M. N78-21490
SUMNER, I. E.
SUMSION, H. T.
SURJAATMADJA, J. B.
SUTORIK, J. A.
SVIRSKY, W.
SWANSON, J. A.
SWEETSER, D.
SWINNERTON, J. W.
SYCHEVA, T. M.
SYMONDS, P. S.

T

TADMOR, E. N78-21846
TAIT, K. S. N78-21706
TAIT, R. A. R. N78-21075
TAKAHASHI, T. N78-21896
TAKATA, A. N. N78-21305
TALCOTT, N. A., JR. N78-21056
TAMAI, S. N78-21330
TANG, F. C. N78-21405
TAUSSIG, R. T. N78-21926
TAYLOR, C. D. N78-21360
TAYLOR, H. M. N78-21498
TAYLOR, J. W. N78-21725
TEGART, J. R. N78-21301
TERASAWA, J. N78-21835
TESCHE, F. M. N78-21349
TETERS, G. A. N78-21222
THACKER, W. C. N78-21421
THOMAS, D. J. N78-21401
THOMAS, E. L. N78-21534
THOMAS, S. W. N78-21706
THOMAS, W. C. N78-21325
N78-21655
THOMPSON, J. F. N78-21840
THOMPSON, R. W. N78-21441
THRALL, R. M. N78-21853
TODD, H. N78-21135
TOEROEK, A. N78-21425
TOMLIN, J. A. N78-21798
TOWNE, C. E. N78-21404
TRABOLD, E. N78-21214
TRAINOR, D. W. N78-21448
TRAUGOTT, S. C. N78-21699
TREAT, N. L. N78-21653
TRIPP, D. A. N78-22009
TROFIMOV, Y. L. N78-21763
TROMBKA, J. I. N78-21546
N78-21558
TROMP, P. J. N78-21492
TRUCK, G. V. N78-21348
TRUE, M. A. N78-21919
TSENG, P. K. C. N78-21369
TSUNG, C. C. N78-21371
TUKEY, J. W. N78-21852
TULLIS, R. H. N78-21095
TULYATHAN, P. N78-21350
N78-21351
TURK, D. R. N78-21972
TURNER, G. B. N78-21600
TURNER, M. D. N78-21329
TURNER, T. W. N78-21297
TYLER, J. S. N78-21091
TYNER, W. E. N78-21990

U

UCKAN, T. N78-21929
UDUPA, S. M. N78-21766
ULABY, F. T. N78-21566
ULANOWICZ, R. E. N78-21551
UNDERWOOD, F. N. N78-21138
UNDERWOOD, J. N78-21066
UNGER, G. E. N78-21543
UNNY, T. E. N78-21624
URABE, Y. N78-21504
URASA, I. T. N78-21230
USMANOVA, M. M. N78-21904

V

VADASZ, A. F. N78-21465
VAKILIAN, M. N78-21662
VANARTSDALEN, E. R. N78-21643
VANDERVAART, J. C. N78-21084
VARGAS-SEMPRUN, D. N78-21508
VARGAS, J. A. N78-21886
VAS, I. E. N78-21420
VEDESHIN, L. A. N78-21192
VILLARD, O. G., JR. N78-21354
VILLE, J. P. N78-21152
VIMUKTA, D. N78-21609
VITALE, R. A. N78-21862
VITKOVITSKY, I. M. N78-21453
VOCAR, J. M. N78-21379
VORTMEIER, F. W. N78-21363

W

WACHS, M. L. N78-21834
WADHWANI, R. M. N78-21818
WAGNER, C. E. N78-21479
WAGNER, J. N78-21775
WAGNER, P. E. N78-21537
N78-21554
WAGONER, B. L. N78-21757
WAKE, L. V. N78-21747
WALDINGER, R. N78-21814
WALKER, H. F. N78-21842
WALRATH, D. E. N78-21225
WALTON, J. R. N78-21844
N78-21857
WARCUP, R. W. N78-21096
WARD, C. E., JR. N78-21676
WARD, M. E. N78-21423
WARFIELD, G. N78-21646
WARTHA, J. H. N78-21584
WATERLAND, L. R. N78-21677
N78-21678
WATERS, W. J. N78-21266
WATSON, R. T. N78-21664
WATSON, T. N78-21617
WEAVER, K. N. N78-21533
N78-21557
WEAVER, R. L. N78-22002
WEAVING, W. S. N78-21725
WEBER, F. P. N78-21564
WEBER, G. W. N78-21217
WEI, D. N78-21872
WEI, K. C. N78-21821
N78-21882
WEISBECKER, L. W. N78-21713
WEISS, B. L. N78-21226
WEISS, C. E. N78-21732
WEISS, R. S. N78-21601
WEISSMAN, P. N78-21173
WELLER, T. N78-21489
WELLER, W. H. N78-21052
WENTWORTH, R. L. N78-21321
WESOKY, H. L. N78-21108
WESOLOWSKI, J. J. N78-21248
WESTBERG, J. E. N78-21620
WETZEL, J. K. N78-21099
WHERRY, R. N78-21974
WHITE, C. L., JR. N78-21548
WHITE, E. A. N78-21120
WHITE, F. A. N78-21431
WHITLOCK, R. N78-21451
WHITON, R. C. N78-21725
WHITTEMORE, T. R. N78-21815
WIEDERHORN, S. M. N78-21296
WIEDERMANN, A. H. N78-21305
WIEGAND, C. L. N78-21509
WIGG, L. D. N78-21131
WILCOX, W. W. N78-21285
WILDER, D. G. N78-21758
WILDER, J. A., JR. N78-21908
WILEY, P. H. N78-21336
WILKERSON, T. D. N78-21526
N78-21536
N78-21549
N78-21558
WILLIAMS, F. W. N78-21237
WILLIAMS, R. G. N78-21506
N78-21881
WILLIAMSON, W. R. N78-21620
N78-21620
WILLMARTH, W. W. N78-21401
N78-21402
WILSON, C. O. N78-21759
WILSON, D. G. N78-21477
WILSON, E. E. N78-21734
WILSON, R. D. N78-21238
WILSON, W. W. N78-21238
WILTON, D. R. N78-21359
WINDBERG, P. N78-21425
WINGET, L. N78-21130
WINTER, J. N78-21135
WINTERS, F. N78-21327
WINTUCKY, E. G. N78-21203
N78-21208
WISE, D. L. N78-21319
N78-21321
WISLER, M. M. N78-21738
WISNER, T. N78-21558
WITHERSPOON, P. A. N78-21631
WOLF, J. S. N78-21281
WONG, L. N78-21952
WOOD, G. M. N78-21431
WOODS, W. A. N78-21810
WOODWARD, O. M. N78-21068
WORK, E. A., JR. N78-21524
WORKMAN, J. B. N78-21698
WORTH, G. M. N78-21789
WRAY, J. R. N78-21530
WU, K. Y. N78-21360
WU, S. T. N78-21574
WULLER, C. E. N78-21376

Y

YANAGIMACHI, A. N78-21330
YANEY, D. N78-21961
YATES, J. T., JR. N78-21239

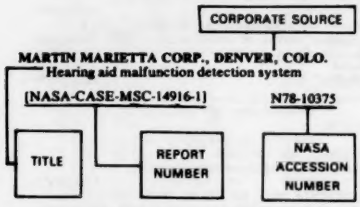
YAU, Y. Y. K. N78-21930
YEN, H. W. N78-21458
YINGLING, R. D. N78-21965
YOON, Y., JOON N78-21833
YOSHINO, T. N78-21330
YOUNG, F. N78-21451
YOUNG, J. F. N78-21450
YOUNG, R. L. N78-21167, N78-21171
YOUNG, W. H., JR. N78-21410
YUE, O. C. N78-21370

Z

ZAK, J. A. N78-21723
ZARETSKY, E. V. N78-21473
ZAVESKY, R. N78-21403
ZEGLEV, R. D. N78-21477
ZELBY, L. W. N78-21652
ZELON, C. C. N78-21105
ZIERKE, J. N78-21788
ZINN, B. T. N78-21244
ZIZSK, G. N78-21153
ZUBEK, J. N78-21392
ZUCKER, O. S. N78-21393
ZUCKERMAN, S. N78-21774
ZVEREV, B. P. N78-21904

CORPORATE SOURCE INDEX

Typical Corporate Source Index Listing



Listings in this index are arranged alphabetically by corporate source. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The NASA accession number denotes the number by which the citation is identified. The titles are arranged under each corporate source in ascending accession number order.

A

ACT SYSTEMS, INC., WINTER PARK, FLA.
The cost of water supply and water utility management, volume 1
[PB-276639/2] N78-21992
The cost of water supply and water utility management, volume 2
[PB-276640] N78-21993

ACUREX CORP., MOUNTAIN VIEW, CALIF.
Preliminary environmental assessment of combustion modification techniques. Volume 1: Summary
[PB-276680/6] N78-21677
Preliminary environmental assessment of combustion modification techniques. Volume 2: Technical results
[PB-276681/4] N78-21678

AD HOC COMMITTEE ON THE USE OF HYDROGEN AS A SUPPLEMENT TO NATURAL GAS.
Evaluation of the use of hydrogen as a supplement to natural gas
[TID-27747] N78-21323

ADDIS TRANSLATIONS INTERNATIONAL, PORTOLA VALLEY, CALIF.
Mechanism of the decomposition of ethylene at low pressure on the surface of rhenium ribbon at high temperature, 2
[BNWL-TR-254] N78-21246

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT, PARIS (FRANCE).
AGARD highlights
[AGARD-HIGHLIGHTS-78/1] N78-21046
Applications of Advances in Navigation to Guidance and Control
[AGARD-CP-220] N78-21071
High temperature problems in gas turbine engines
[AGARD-CP-229] N78-21118
Cobalt-base alloys for hot corrosion protective coatings
N78-21142

AEROJET ELECTROSYSTEMS CO., AZUSA, CALIF.
Thin-film bucket brigade device charge-transfer efficiency improvements for display applications
[AD-A050475] N78-21387
Snow parameters from Nimbus-6 electrically scanned microwave radiometer
[NASA-CR-156725] N78-21572

AERONAUTICAL RESEARCH ASSOCIATES OF PRINCETON, INC., N. J.
A reacting turbulent boundary layer approach to solid propellant erosive burning
[AD-A049537] N78-21307

AERONAUTICAL RESEARCH INST. OF SWEDEN, STOCKHOLM.
Transonic wind tunnel tests on two-dimensional aerofoil sections. Determination of pressure distribution and drag for an aerofoil with a modified NACA 65 sub2-215 section in FFA wind tunnel S5, part 2
[FFA-TN-AU-725] N78-21062

AERONAUTICAL RESEARCH LABS., MELBOURNE (AUSTRALIA).
A brief examination of the flow external to an F-111 intake at Mach 1.6
[ARL/ME-NOTE-357] N78-21054

AERONUTRONIC FORD CORP., NEWPORT BEACH, CALIF.
Laminar boundary layer stability measurements at Mach 7 including wall temperature effects
[AD-A049535] N78-21415

AERONUTRONIC FORD CORP., PALO ALTO, CALIF.
SMS/GOES cell and battery data analysis report
[NASA-CR-156739] N78-21606

AEROSPACE CORP., EL SEGUNDO, CALIF.
Theory of trace element detection from a static thermal induction plasma
[ATR-78(8209)-1] N78-21233
Emission spectrum of the NU3 band of SF6 at 1780K
[AD-A049865] N78-21242
A gradient projection-multiplier method for nonlinear programming
[AD-A049864] N78-21811

AGBABIAN ASSOCIATES, EL SEGUNDO, CALIF.
Pulse applications and parameter identification for US Navy medium-weight shock machine
[AD-A050120] N78-21500

AGRICULTURAL RESEARCH SERVICE, PHOENIX, ARIZ.
Heat capacity mapping mission ground measurements
[E78-10113] N78-21518

AGRICULTURAL RESEARCH SERVICE, WESLACO, TEX.
Plant cover, soil temperature, freeze, water stress, and evapotranspiration
[E78-10101] N78-21509

AIR FORCE AERO PROPULSION LAB., WRIGHT-PATTERSON AFB, OHIO.
Low frequency combustion instability in augmentors
N78-21138

AIR FORCE CIVIL ENGINEERING CENTER, TYNDALL AFB, FLA.
Runway roughness evaluation laser profilometer implementation study
[AD-A049440] N78-21165

AIR FORCE GEOPHYSICS LAB., HANSCOM AFB, MASS.
Thermochemical and kinetic data of gaseous metal oxides and their relationship to atmospheric composition
[AD-A050162] N78-21700

AIR FORCE HUMAN RESOURCES LAB., BROOKS AFB, TEX.
Visual-proprioceptive cue conflicts in the control of remotely piloted vehicles
[AD-A049706] N78-21770

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO.
Approximate solutions to the radiative transfer equation using the Elsasser scheme
[AD-A049933] N78-21703
A study of the characteristics of the data systems test kinematic fields
[AD-A050060] N78-21721
Forecasting thunderstorms over a 2-to-5-h period by statistical methods
[AD-A050005] N78-21723
Characteristic size spectra of cumulus fields observed from satellites
[AD-A049936] N78-21724
Solutions to the Kalman filter wordlength problem: Square root and U-D covariance factorizations
[AD-A049704] N78-21854

AIR FORCE SYSTEMS COMMAND, WRIGHT-PATTERSON AFB, OHIO.
Fuel pressure increase limiter
[AD-A049393] N78-21117
Method of plastic deformation of metals and alloys
[AD-A049391] N78-21280
Current pulse generator with amplitude of 1,000,000 A and stability of plus or minus .001 at a repetition rate of two Hz
[AD-A049390] N78-21390
A control system for depicting information from computer on an electroluminophoric plate
[AD-A049394] N78-21788

AIR FORCE WEAPONS LAB., KIRTLAND AFB, N. MEX.
Radiation characterization of sequential logic circuits
[AD-A050476] N78-21388

AIR POLLUTION TECHNOLOGY, INC., SAN DIEGO, CALIF.
American Air Filter Kinpactor 10 x 56 venturi scrubber evaluation
[PB-276716/8] N78-21682

AIR WEATHER SERVICE, SCOTT AFB, ILL.
Selected topics in statistical meteorology
[AD-A050035] N78-21725

AIRESEARCH MFG. CO., TORRANCE, CALIF.
Design, fabrication, and testing of a full-scale breadboard in nitrogen generator for fuel tank inerting application
[AD-A049459] N78-21097

AMERICAN UNIV., WASHINGTON, D. C.
Inferring nutrient loading of estuarine systems by remote sensing of aquatic vegetation
N78-21552

ANALYTIC SCIENCES CORP., READING, MASS.
GEOFAST: A fast gravimetric estimation algorithm
[AD-A047611] N78-21706

ANALYTICS, INC., WILLOW GROVE, PA.
Operational decision aids: The application of nomography and uncertainty analysis to decision-aiding systems
[AD-A049545] N78-21974

ARGONNE NATIONAL LAB., ILL.
Dynamic instability analysis of axisymmetric shells by finite element method with convected coordinates
[CONF-770807-34] N78-21505
Proceedings of the Energy Research and Development Administration Conference on Cogeneration and Integrated Energy/Utility Systems
[CONF-770632] N78-21644
MINKIT: An optimization system
[ANL-AMD-TM-305] N78-21817
Quantitative determination of surface temperatures using an infrared camera
[CONF-770868-2] N78-21916

ARINC RESEARCH CORP., ANNAPOLIS, MD.
Investigation to support phase 1 of the USAF midair prevention systems program (MAPS)
[AD-A049743] N78-21066

ARIZONA UNIV., TUCSON.
Excitation of a wire in a rectangular cavity. Part 1: Theory
[AD-A050073] N78-21365
Excitation of a wire in a rectangular cavity. Part 2: Computer documentation
[AD-A050074] N78-21366
Direct numerical solution of large sets of simultaneous equations
[AD-A050058] N78-21850

ARMY AEROMEDICAL RESEARCH LAB., FORT RUCKER, ALA.
Helmet cold conditioning: Correlation of structural temperatures in actual and simulated cold environments
[AD-A050033] N78-21769

ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND, ABERDEEN PROVING GROUND, MD.
Anomalous infrared emission from condensing and cooling steam clouds
[AD-A050083] N78-21914

ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND, DOVER, N. J.
Complex formation in RDX, HMX, TNT, and some related compounds: A bibliography
[AD-A050090] N78-21306

ARMY AVIATION RESEARCH AND DEVELOPMENT COMMAND, ST. LOUIS, MO.
A computerized log for Systems and Cost Analysis Division Cost Estimate Control Data Center (CECDC) validation activity
[AD-A049976] N78-21984

ARMY COMMUNICATIONS-ELECTRONICS ENGINEERING INSTALLATION AGENCY, FORT HUACHUCA, ARIZ.
Antenna selection for ionospheric telecommunication systems
[AD-A049549] N78-21364
ARMY CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, ILL.
Development of a pavement maintenance management system. Volume 2: Airfield pavement distress identification manual
[AD-A049029] N78-21170
ARMY ELECTRONICS COMMAND, FORT MONMOUTH, N. J.
Computer Family Architecture Selection Committee. Volume 3: Evaluation of computer architecture via test programs
[AD-A049482] N78-21773
Computer Family Architecture Selection Committee. Volume 4: Architectural research facility ISP description, simulations, data collection
[AD-A049483] N78-21774
Computer Family Architecture Selection Committee. Volume 5: Procedure for and results of the evaluations of software bases of the candidate architectures for the military computer family
[AD-A049484] N78-21775
Computer family architecture selection committee. Volume 6: Life cycle cost models
[AD-A049487] N78-21776
Computer family architecture selection committee. Volume 8: CFA final selection
[AD-A049485] N78-21777
Computer family architecture selection committee. Volume 9: A consideration of issues in the selection of a computer family architecture
[AD-A049486] N78-21778
Computer family architecture selection committee. Volume 2: Selection of candidate architectures and initial screening
[AD-A049457] N78-21779
Computer family architecture selection committee
[AD-A049466] N78-21781
Computer family architecture selection committee. Volume 1: Introduction
[AD-A049468] N78-21782
ARMY ENGINEER TOPOGRAPHIC LABS., FORT BELVOIR, VA.
Chemical array studies
[AD-A050024] N78-21577
ARMY ENVIRONMENTAL HYGIENE AGENCY, ABERDEEN PROVING GROUND, MD.
Laser hazards bibliography, August 1977 eighth edition
[AD-A047606] N78-21457
ARMY FACILITIES ENGINEERING SUPPORT AGENCY, FORT BELVOIR, VA.
Installation energy control system analysis program
[AD-A049488] N78-21615
ARMY WAR COLL., CARLISLE BARRACKS, PA.
A turning point in space: Has the time arrived for a national review of our space policy
[AD-A049926] N78-21182
ATLANTIC RESEARCH CORP., ALEXANDRIA, VA.
Safety evaluation of distress flares and smokes
[AD-A049969] N78-21309
ATMOSPHERIC SCIENCES LAB., WHITE SANDS MISSILE RANGE, N. MEX.
Atmospheric diffusion: Similarity theory and empirical derivations for use in boundary layer diffusion problems
[AD-A050027] N78-21701
The 12829C Lance missile no. 4236, round no. 299 RSL, 25 August 1977
[AD-A049435] N78-21726
The 14821A Lance missile no. 3294, round no. 301 APL, 5 October 1977
[AD-A049431] N78-21727
The 14823A Lance missile no. 3293, round no. 300 AST 5 October 1977
[AD-A049430] N78-21728
ATOMIC ENERGY ORGANIZATION OF IRAN, TEHERAN.
Study of some recent advances in the concept and design of MHD generators
[AEOI-26] N78-21662
AUBURN UNIV., ALA.
Transient analysis of a finite length cylindrical scatterer very near a perfectly conducting ground, part 1
[AD-A050143] N78-21342
Transient analysis of a finite length cylindrical scatterer very near a perfectly conducting ground, part 2
[AD-A050144] N78-21343
AVCO-EVERETT RESEARCH LAB., EVERETT, MASS.
Optical conversion processes
[AD-A049583] N78-21448
Small scale discharge studies
[AD-A049551] N78-21456
AVCO RESEARCH AND SYSTEMS GROUP, WILMINGTON, MASS.
Study of the ablative effects on tektites: Atmosphere entry of a swarm of tektites
[NASA-CR-156733] N78-22007
AVCO SYSTEMS DIV., WILMINGTON, MASS.
Installation and test of Doppler acoustic sensor
[AD-A049562] N78-21893

B

BABCOCK AND WILCOX CO., LYNCHBURG, VA.
A 1/3 scale air-water pump program, analytical pump performance model. Volume 1: Key phase report
[EPRI-NP-160-VOL-1] N78-21478
BATTELLE COLUMBUS LABS., OHIO.
The fate of nitrogen oxides in the atmosphere: Summary of an exploratory study in Phoenix, Arizona
[PB-276355/5] N78-21707
BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WASH.
Mechanism of the decomposition of ethylene at low pressure on the surface of rhenium ribbon at high temperature, 2
[BNWL-TR-254] N78-21246
Geothermal energy potential for district and process heating applications in the US: An economic analysis
[BNWL-2311] N78-21649
Description and comparison of energy impact assessment models
[BNWL-2107] N78-21671
BECHTEL CORP., SAN FRANCISCO, CALIF.
Definition of requirements for geothermal power conversion system studies
[UCRL-13751] N78-21650
BENDIX CORP., KANSAS CITY, MO.
Laboratory automatic data acquisition system
[BDX-613-1566] N78-21435
BIGELOW LAB. FOR OCEAN SCIENCES, WEST BOOTHBAY HARBOR, MAINE.
Coastal upwelling ecosystems analysis. Data report 41: Physical, chemical and biological observations from JOINT 2 R/V ALPHA HELIX, Leg O, 5-20 March 1976
[PB-276297/9] N78-21745
BIOSPHERICS, INC., ROCKVILLE, MD.
Technology for return of planetary samples, 1977
[NASA-CR-156169] N78-21181
BOEING AEROSPACE CO., SEATTLE, WASH.
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 1: Program summary and data analysis
[NASA-CR-135369] N78-21493
Analysis and test of deep flaws in thin sheets of aluminum and titanium. Volume 2: Crack opening displacement and stress-strain data
[NASA-CR-135370] N78-21494
BOEING VERTOL CO., PHILADELPHIA, PA.
Research requirements to improve reliability of civil helicopters
[NASA-CR-145335] N78-21093
Bearingless tail rotor loads and stability
[AD-A049579] N78-21098
Heavy lift helicopter flight control system. Volume 2: Primary flight control system development and feasibility demonstration
[AD-A049580] N78-21163
Heavy lift helicopter flight control system. Volume 3: Automatic flight control system development and feasibility demonstration
[AD-A050059] N78-21164
BOLT, BERANEK, AND NEWMAN, INC., CAMBRIDGE, MASS.
Research in natural language understanding
[AD-A049781] N78-21810
BRISTOL UNIV. [ENGLAND].
The physical mechanisms responsible for the weathering of epoxy resins and GFR epoxy resins
[AD-A049796] N78-21297
BRITISH BROADCASTING CORP., KINGSWOOD [ENGLAND].
Computation of groundwave attenuation over irregular and inhomogeneous ground at low and medium frequencies
[BBC-RD-1978/7] N78-21332
BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
Energy systems analysis and development
[BNL-22969] N78-21633
Planner's energy workbook: A manual for exploring relationships between land use and energy utilization
[BNL-50633] N78-21634
BROWN UNIV., PROVIDENCE, R. I.
Finite viscoplastic deflections of an impulsively loaded plate by the mode approximation technique
[AD-A049827] N78-21499
Experiments on viscoplastic response of circular plates to impulsive loading
[AD-A049866] N78-21502
On minimum energy control of commutative bilinear systems
[AD-A049500] N78-21821
A double integral quadratic cost problem with application to feedback stabilization
[AD-A049533] N78-21822
A Liapunov functional for a matrix neutral difference-differential equation with one display
[AD-A049868] N78-21859
Global controllability for a class of bilinear systems
[AD-A049518] N78-21882
A modified quadratic cost problem and feedback stabilization of linear discrete time systems
[AD-A049519] N78-21883
On feedback stabilization of time varying discrete linear systems
[AD-A049530] N78-21884
BUREAU OF RECLAMATION, DENVER, COLO.
An assembly-language minicomputer software development system
[PB-276108/8] N78-21815
BUREAU OF THE CENSUS, WASHINGTON, D. C.
Annual survey of manufactures, 1975. Fuels and electric energy consumed. Statistics for the United States
[PB-275772/2] N78-21659

C

CACI, INC., ARLINGTON, VA.
Executive aids for crisis management
[AD-A049954] N78-21975
CALIFORNIA INST. OF TECH., PASADENA.
On the dissipation associated with equilibrium shocks in finite elasticity
[AD-A050031] N78-21501
Collision detection and avoidance in computer controlled manipulators
N78-21766
The problem of exit against a flow for dynamical systems
N78-21881
Superconductivity, spin-glass properties, and ferromagnetism in amorphous La-Gd-Au alloys
N78-21951
Far infrared observations of the galactic center
N78-21996
CALIFORNIA STATE DEPT. OF HEALTH, BERKELEY.
Comparison of wet chemical and instrumental methods for measuring airborne sulfate
[PB-276620/2] N78-21248
CALIFORNIA STATE DEPT. OF HOUSING AND COMMUNITY DEVELOPMENT, SACRAMENTO.
California residential energy standards: Problems and recommendations relating to implementation, enforcement, design
[SAN/1178-1] N78-21640
CALIFORNIA STATE DEPT. OF TRANSPORTATION, SACRAMENTO.
CALINE 2: An improved microscale model for the dispersion of air pollutants from a line source
[PB-275683/1] N78-21676
CALIFORNIA STATE DEPT. OF WATER RESOURCES, SACRAMENTO.
Water resources data for California, water year 1976. Volume 3: Southern central valley basins, and the great basin from Walker River to Truckee River
[PB-276354/8] N78-21586
CALIFORNIA STATE UNIV., NORTHRIDGE.
Ball to separator contact forces in angular contact ball bearings under thrust and radial loads
[NASA-CR-2976] N78-21469
CALIFORNIA UNIV., BERKELEY.
The influence of retained austenite on the thick section mechanical properties of a commercial low alloy ultra-high strength steel
N78-21254
An integrated study of earth resources in the state of California using remote sensing techniques
[E78-10115] N78-21520
Optical quadrupole sum frequency generation in metal vapor
N78-21907
Nonlinear optical effects in liquid crystals
N78-21937
Performance limits of a Josephson junction mixer
[AD-A049544] N78-21963
Spectrophotometric investigations of white dwarf stars
N78-21994
Two theoretical problems in close binary stars
N78-21995
CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.
Study of treatment methods for geothermal fluids
[LBL-6337] N78-21622
Distributed technologies in California's energy future, volume 1
[LBL-6831-VOL-1] N78-21623
Results of reservoir evaluation tests, 1976 East Mesa Geothermal Field, California
[LBL-6369] N78-21631
Distributed technologies in California's energy future: A preliminary report, volume 2
[LBL-6831-VOL-2] N78-21635
Catalyzed combustion in a flat plate boundary layer. 1: Experimental measurements and comparison with numerical calculations
[LBL-6841] N78-21636
Analysis of the bipole-dipole resistivity method for geothermal exploration
[LBL-6332] N78-21710

Semiclassical methods for nonseparable systems
[LBL-6662] N78-21903

CALIFORNIA UNIV., IRVINE.
Theoretical studies of optical phenomena in solids
N78-21946

CALIFORNIA UNIV., LIVERMORE. LAWRENCE LIVERMORE LAB.
Determination of sound velocity in liquid metals at temperatures above 4000 K
[UCRL-79322-REV-1] N78-21285
Thermophysical and transport properties of metals at high pressure and very high temperature
[UCRL-79586] N78-21286
Alternative fuels for transportation: Implications of the broad-cut option
[UCRL-52313] N78-21322
Evaluation of two computer programs for modeling electromagnetic interactions with surfaces
[UCRL-52321] N78-21368
Light activated semiconductor switches
[UCRL-80046] N78-21393
Role of statistical linearization in the solution of nonlinear stochastic equations
[UCRL-80094] N78-21867
Design of an electrostatic end-plugged plasma-confinement device
[UCRL-79880] N78-21928
Some highlights of theoretical and computational plasma physics, part 2
[UCRL-79600-PT-2] N78-21936
Decision making with interactive access to integrated administrative and technological data bases. An illustrated conceptual overview
[UCRL-80353] N78-21986

CALIFORNIA UNIV., LOS ANGELES.
A study of the effect of carbon upon the elevated temperature mechanical, fracture and static load crack extension behavior of austenitic stainless steel
N78-21255
Cryogenic-coolant He-4-superconductor interaction
[NASA-CR-2963] N78-21406
Pupillometric signs of brain activation vary with level of cognitive processing
[AD-A050029] N78-21757
Activation and sustained attention: A pupillometric study of an auditory vigilance task
[AD-A050040] N78-21759
Boundary-dependent stability criteria for difference approximations of hyperbolic problems, I
[AD-A049501] N78-21846
Non-radial p mode oscillations as a seismic probe of solar structure
N78-22008

CALIFORNIA UNIV., SAN DIEGO.
Approximations for the amplitude distribution and density of shot processes
N78-21370
Conductivity of the ocean crust
N78-21686
Discrete variational techniques in finite mathematics
N78-21834
An incoherent optical implementation of the two-dimensional Walsh transform
N78-21911
Characterization of surfaces by low energy helium scattering
N78-21941
Long range interactions between atoms absorbed on surfaces
N78-21944
Prospects for studying gas chemisorption kinetics using current fluctuations
N78-21953

CALIFORNIA UNIV., SAN DIEGO, LA JOLLA.
Binding energy and effectiveness mass of charged particles trapped on surfaces
[AD-A049945] N78-21964
Hard X-ray imaging facility for space shuttle: A scientific and conceptual engineering study
[NASA-CR-156736] N78-22016

CARNEGIE INST. OF TECH., PITTSBURGH, PA.
Heat transfer research and power cycle transient modeling
[COO-2641-4] N78-21424

CARNEGIE-MELLON UNIV., PITTSBURGH, PA.
Notes for a model of human performance in ZOG
[AD-A049532] N78-21783
L-STAR: An interactive, symbolic implementation system
[AD-A050119] N78-21785

CASE WESTERN RESERVE UNIV., CLEVELAND, OHIO.
Investigation of the surface roughness of evaporated copper films by optical scattering
N78-21252
Influence of metal variables on the structure and properties of heavy section ductile iron
N78-21253
Investigations of the biological effects of radiation: A multi-discipline approach
[COO-2486-366] N78-21760

CATHOLIC UNIV. OF AMERICA, WASHINGTON, D. C.
Parabolic profiling by the molecular stuffing process
N78-21908

CENTRE DE VILLAROCHE, MOISSY (FRANCE).
A review of techniques for the thermal protection of the walls of the combustion chamber and reheating ducts of turboreactors
N78-21134

CENTRO PER L'AUTOMATICA E. PIAGGIO, PISA (ITALY).
High temperature H2-Air variable geometry combustor and turbine: Test facility and measurements
N78-21137

CHRYSLER CORP., DETROIT, MICH.
Baseline gas turbine development program
[COO-2749-18] N78-21479

CINCINNATI UNIV., OHIO.
The effect of varying quench rates and heating rates on the aging response of an aluminum powder alloy
[AD-A0497444] N78-21272

CITY OF TRENTON, N. J.
Trenton ICES, volume I, phase I
[COO/4212-1/1-VOL-1] N78-21639

CITY UNIV. OF NEW YORK.
Stationary stochastic and discrete Markov process. Part 1: The range of a strictly stationary stochastic process. Part 2: Some additional results concerning limits of a discrete Markov process
N78-21868
Relativistic neutron gas interacting through a spin 2 field and its astrophysical applications
N78-22004

CIVIL AEROMEDICAL INST., OKLAHOMA CITY, OKLA.
Effects of ethanol on visual unit activity in the thalamus
[AD-A050922] N78-21754
Aircrew and passenger protective breathing equipment studies
[AD-A051002] N78-21768

CLEMSON UNIV., S.C.
Anisothermal oxidation of titanium and its alloy
[AD-A050053] N78-21281
Dynamic hyperfiltration membranes for high-temperature spacecraft wash water recycle
[NASA-CR-151689] N78-21767

COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA.
Theory of amorphous CuNi alloys
N78-21250

COLORADO DIV. OF WATER RESOURCES, DENVER.
Analyses of methods for the determination of water availability for energy development
[FEA/G-77/059] N78-21580

COLORADO STATE UNIV., FORT COLLINS.
Analytical capabilities of a dc plasma-echelle spectrometer system
N78-21230
On the stochastic modeling of daily streamflows
N78-21508
Analyses of methods for the determination of water availability for energy development
[FEA/G-77/059] N78-21580
Orographic precipitation model for hydrometeorological use
N78-21714
Physical mechanisms of extra area effects from weather modification
N78-21715
Proceedings of the 1st Annual Rocky Mountain Symposium on Microcomputers: Systems, Software, Architecture
[AD-A049559] N78-21786
Theory of large agglomerates in magnetic colloids
N78-21921

COLT INDUSTRIES, INC., PITTSBURGH, PA.
Fabrication of stainless steel clad tubing
[NASA-CP-135347] N78-21265

COLUMBIA UNIV., NEW YORK.
Research investigation directed toward extending the useful range of the electromagnetic spectrum
[NASA-CR-156069] N78-21236
A geophysical investigation of the oceanographer fracture zone and the mid-Atlantic ridge in the vicinity of 35 deg north
N78-21683
Temperature fine-structure in the Southern Ocean
N78-21735
A character formula for the discrete series of a semisimple lie group
N78-21886
A survey of carbon monoxide in Cygnus X
N78-21997

COMMERCE DEPT., WASHINGTON, D.C.
World weather program. Plan for fiscal year 1978
[PB-276479/3] N78-21718

COMMITTEE ON FINANCE (U. S. SENATE).
Incentives for developing new energy sources
[GPO-93-810] N78-21613

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION (U. S. HOUSE).
Use of solar energy in Federal Building
[GPO-94-365] N78-21610
Airport and aircraft noise reduction
[GPO-91-591] N78-21891

COMMONWEALTH RESEARCH CORP., CHICAGO, ILL.
Gasification combined cycle test facility, Pekin, Illinois
[FE-2352-03] N78-21632

COMMUNICATIONS RESEARCH CENTRE, OTTAWA (ONTARIO).
Ionospheric effects on the Doppler frequency shift in SARSAT propagation
[CRC-1313] N78-21334
The radio climatology of Canada. Tropospheric refractivity atlas for Canada
[CRC-1315-E] N78-21689

CORNELL-SYDNEY UNIV. ASTRONOMY CENTER, SYDNEY (AUSTRALIA).
The time to failure of cables subjected to random loads
[AD-A049585] N78-21498

CORNELL UNIV., ITHACA, N. Y.
The long-period motion of geosynchronous satellites
N78-21187
Relationships between structure and micromechanics of solvent crazes in glassy polymers
N78-21288
Higher order effects, stability and transition in vertical natural convection flows
N78-21394
Kinetics of model chemical reactions
N78-21894
Simulation model for resource policy evaluation
[PB-275938/9] N78-21990
On the theory and analysis of occultation light curves
N78-22005

CORNELL UNIV., NEW YORK.
Separation of lymphocytes by electrophoresis under terrestrial conditions and at zero gravity, phase 3
[NASA-CR-151702] N78-21753
Generation and behavior of long-lived field reversing electron rings in strong toroidal fields
N78-21920
Chemisorption and reaction mechanisms on iron and iridium surfaces
N78-21955
Considerations on dense matter in astrophysics
N78-22002

CORPS OF ENGINEERS, BALTIMORE, MD.
Hydraulic model of the Chesapeake Bay
N78-21539
An overview of dredging operations in the Chesapeake Bay
N78-21545

D

DAVID SARNOFF RESEARCH CENTER, PRINCETON, N.J.
Epitaxial growth of semi-insulating GaAs
[AD-A050030] N78-21961

DAYTON UNIV. RESEARCH INST., OHIO.
Test and development of inflatable spheres instrumented with miniaturized thermistors, accelerometers and pressure transducers
[NASA-CR-2968] N78-21428
An evaluation of electrochemical concentration Cell [ECC] sonde measurements of atmospheric ozone
[NASA-CR-2973] N78-21429

DE LAUREAL ENGINEERS, INC., NEW ORLEANS, LA.
Grid-connected ICES preliminary feasibility analysis and evaluation. Volume 1: Executive summary
[COO/4214-1/1-VOL-1] N78-21641

DECISIONS AND DESIGNS, INC., MCLEAN, VA.
Satellite surveillance avoidance optimization aid
[AD-A049561] N78-21195

DEFENSE COMMUNICATIONS ENGINEERING CENTER, RESTON, VA.
Performance measurements of the CVSD speech coding algorithm
[AD-A050163] N78-21362
An evaluation of data information transfer requirements for the future DCS
[AD-A049664] N78-21780

DELAWARE UNIV., NEWARK.
Improved semiconductors for photovoltaic solar cells
[DSE/2460-2] N78-21646

DEPARTMENT OF ENERGY, WASHINGTON, D. C.
Natural circulation calculation: Single-phase and two-phase flow in pipes
[DOE-TR-15] N78-21425

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, BRUNSWICK (WEST GERMANY).
Calibration of an IRS based on flight data
N78-21076
Accuracy considerations on new Microwave Landing Systems (MLS) from an operational point of view
N78-21081
Improved aircraft tracking using maneuver statistics enroute and in the terminal area
N78-21087

A hybrid guidance system for all-weather approach and landing
N78-21088

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, COLOGNE [WEST GERMANY].
Investigation on temperature distribution near film cooled airfoils
N78-21127

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, GOETTINGEN [WEST GERMANY].
The influence of jets of cooling air exhausted from the trailing edges of a supercritical turbine cascade on the aerodynamic data
N78-21148

DOUGLAS AIRCRAFT CO., INC., LONG BEACH, CALIF.
Evaluation of windshield materials subjected to simulated supersonic flight
[AD-A049981] N78-21101
Aircraft cargo compartment fire test simulation program
[NASA-CR-151951] N78-21223

DOW CHEMICAL CO., MIDLAND, MICH.
Chemicals from coal: USBM Synthoil
[FE-1534-49] N78-21320

DOW CHEMICAL CO., WALNUT CREEK, CALIF.
Design, fabrication, and testing of a full-scale breadboard in nitrogen generator for fuel tank inerting application
[AD-A049459] N78-21097

DREXEL UNIV., PHILADELPHIA, PA.
Incentives for the generation, dissemination and use of scientific and technical information
[PB-276180/7] N78-21985

DUKE UNIV., DURHAM, N. C.
Application and theoretical studies of silver and mercuric sulfide-based ion selective electrodes
N78-21369

DYNATECH R/D CO., CAMBRIDGE, MASS.
Investigation of converting the product of coal gasification to methane by the action of microorganisms, phase 1
[FE-2203-16] N78-21319
Fuel gas production from animal waste, phase 1
[COO-2991-17] N78-21321

E

ECOLOGY CONSULTANTS, INC., FORT COLLINS, COLO.
Annotated bibliography of natural resource information: Northwestern Colorado
[PB-275997/5] N78-21579

ECON, INC., PRINCETON, N. J.
The First Seasat-A Industrial Users Workshop
[NASA-CR-156149] N78-21573

EDGERTON, GERMESHAUSEN AND GRIER, INC., IDAHO FALLS, IDAHO.
Energy oriented study of industrial cyclone separators
[TREE-1174] N78-21642

ELCAM, INC., SANTA BARBARA, CALIF.
Prototype solar heated hot water systems and double-walled heat exchangers: A collection of quarterly reports
[NASA-CR-150591] N78-21591

ELECTRIC POWER RESEARCH INST., PALO ALTO, CALIF.
Four Workshops in Alternate Concepts in Controlled Fusion. Part A: Executive summaries. Part B: Extended summaries. Part C: CTR using the p-B-11 reaction
[EPRI-ER-429-SR-PT-A] N78-21927

ELECTRICITY COUNCIL RESEARCH CENTER, CAPENHURST [ENGLAND].
Metallography of commercial lead and lead alloys used in the electricity supply industry
[PB-276437/1] N78-21287

ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER, ANNAPOLIS, MD.
Target acquisition contours generated for RCAG/BUEC sites in the contiguous United States
[AD-A050978] N78-21335

ENERGY, INC., IDAHO FALLS, IDAHO.
Energy supply and environmental impacts: Conventional energy sources
[PB-276410/8] N78-21669

ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, BARTLESVILLE, OKLA.
Diesel fuel oils, 1977
[BERC/PPS-77/5] N78-21324

ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, WASHINGTON, D. C.
Low-Btu coal gasification
[ERHQ-0015] N78-21318

ENERGY TASK FORCE, INC., NEW YORK.
Windmill power for city people
[PB-275658/3] N78-21654

ENVIRONMENTAL MEASUREMENTS, INC., ANNAPOLIS, MD.
Work on power-plant [air] plumes involving remote sensing of SO2
N78-21548

ENVIRONMENTAL PROTECTION AGENCY, PHILADELPHIA, PA.
The Chesapeake Bay Program: An opportunity to use an innovative monitoring technique
N78-21528

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, D. C.
The Chesapeake Bay: A challenge to the remote sensing community
N78-21535

ENVIRONMENTAL RESEARCH AND TECHNOLOGY, INC., CONCORD, MASS.
Investigation of the application of HCMM thermal data to snow hydrology
[E78-10116] N78-21521

ENVIRONMENTAL RESEARCH INST. OF MICHIGAN, ANN ARBOR.
Use of LANDSAT data to assess waterfowl habitat quality
[E78-10120] N78-21524

ENVIRONMENTAL SCIENCES RESEARCH LAB., RESEARCH TRIANGLE PARK, N.C.
International Conference on Oxidants, 1976: Analysis of Evidence and Viewpoints. Part 1: Definition of key issues
[PB-276768/9] N78-21679

ERNST AND ERNST, WASHINGTON, D. C.
The long-run incremental cost of electric utilities
[PB-276082/5] N78-21660

F

FAIRCHILD IMAGING SYSTEMS, SYOSSET, N. Y.
Engineering study for pallet adapting the Apollo laser altimeter and photographic camera system for the Lidar Test Experiment on orbital flight tests 2 and 4
[NASA-CR-152615] N78-21525

FAIRCHILD REPUBLIC CO., FARMINGDALE, N. Y.
Pulsed plasma radio frequency interference studies
[AD-A049581] N78-21355

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, D. C.
Projected 1977 - 1978 winter electric load-supply situation, contiguous United States
[PB-276269/8] N78-21621

FERRANTI LTD., EDINBURGH [SCOTLAND].
Recent advances in high resolution inertial navigation
N78-21075
Navigation, guidance and control for high performance military aircraft
N78-21090

FLORIDA UNIV., EGLIN AFB.
Studies on the failure of metal mechanical joints subjected to dynamic loads
[AD-A050076] N78-21503

FLORIDA UNIV., GAINESVILLE.
Stability of an infinite system of differential equations
N78-21833
Group replacement of a multicomponent system which is subject to deterioration only
[AD-A049502] N78-21971

FLUOROCHEM, INC., AZUSA, CALIF.
High energy halogen chemistry
[AD-A049555] N78-21240

FOREST SERVICE, WASHINGTON, D. C.
Operational programs in forest management and priority in the utilization of remote sensing
N78-21531

FUTURES GROUP, GASTONBURY, CONN.
Alternative future scenarios for the national system. Volume 1: Executive summary
[AD-A047084] N78-21065

G

GCA CORP., BEDFORD, MASS.
Filtration model for coal fly ash with glass fabrics
[PB-276489/2] N78-21667

GENERAL ACCOUNTING OFFICE, WASHINGTON, D. C.
Emergency natural gas purchases: Actions needed to correct program abuses and consumer inequities
[PB-275876/1] N78-21313
US energy conservation could benefit from experiences of other countries
[PB-276006/4] N78-21619
Summaries of conclusions and recommendations on the operations of civil departments and agencies
[PB-276094/0] N78-21976
Economies available through improved inventory management
[PB-276048/6] N78-21977
Federal agencies should be given multiyear contracting authority for supplies and services
[PB-276028/8] N78-21978
A range of cost measuring risk and uncertainty in major programs: An aid to decision making
[PB-276384/5] N78-21979

GENERAL APPLIED SCIENCE LABS., INC., WESTBURY, N. Y.
Unsteady plume and blast field generated by a rocket launch
[AD-A050000] N78-21213

GENERAL DYNAMICS/ASTRONAUTICS, SAN DIEGO, CALIF.
Payload planning information development study
[NASA-CR-150633] N78-21175

GENERAL ELECTRIC CO., CINCINNATI, OHIO.
Wind tunnel performance tests of coannular plug nozzles
[NASA-CR-2990] N78-21044

GENERAL ELECTRIC CO., EVENDALE, OHIO.
Effects of film injection on performance of a cooled turbine
N78-21147

GENERAL ELECTRIC CO., PHILADELPHIA, PA.
LANDSAT-1 and LANDSAT-2 flight evaluation report
[E78-10105] N78-21511
LANDSAT-C flight activation plan
[E78-10106] N78-21512

GENERAL ELECTRIC CO., SCHENECTADY, N. Y.
Study of practical cycles for geothermal power plants
[COO-2619-1] N78-21651

GEOLOGICAL SURVEY, MENLO PARK, CALIF.
Water resources data for California, water year 1976. Volume 3: Southern central valley basins, and the great basin from Walker River to Truckee River
[PB-276354/8] N78-21586

GEOLOGICAL SURVEY, RESTON, VA.
Activities of the US Geological Survey in Applications of Remote Sensing in the Chesapeake Bay Region
N78-21530

GEOLOGICAL SURVEY, TACOMA, WASH.
Water resources data for Washington, water year 1976. Volume 1: Western Washington
[PB-275886/0] N78-21581
Water resources data for Washington, water year 1976. Volume 2: Eastern Washington
[PB-275887/8] N78-21582

GEOLOGICAL SURVEY, TALLAHASSEE, FLA.
Aquifer test analyses for the Floridan aquifer in Flagler, Putnam, and St. Johns counties, Florida
[PB-275790/4] N78-21583

GEORGIA INST. OF TECH., ATLANTA.
Experiments related to external burning for propulsion
[AD-A047623] N78-21241
Investigation of the properties of the combustion products generated by building fires
[PB-276549/3] N78-21244
Optical surface studies of titanium and titanium-aluminum alloys with application to the mechanism of passivity and non-destructive testing
[AD-A050212] N78-21276
Audible and ultrasonic acoustic emissions from composite solid propellants
[AD-A049517] N78-21304

GEORGIA UNIV., ATHENS.
Development of a practical photochemical energy storage system
[SRO-893-6] N78-21626
Development of a practical photochemical energy storage system
[SRO-893-8] N78-21627
Development of a practical photochemical energy storage system
[SRO-893-9] N78-21628
Development of a practical photochemical energy storage system
[SRO-893-10] N78-21629
Interactive statistical software
[AD-A049707] N78-21874

GOODYEAR AEROSPACE CORP., AKRON, OHIO.
Associative array processing of raster scanned data for automated cartography II: Improved resolution and data handling
[AD-A049698] N78-21379

GTE SYLVANIA, INC., NEEDHAM HEIGHTS, MASS.
Traffic flow, performance and interface characterization study for Europe
[AD-A049462] N78-21353

H

HARRIS CORP., MELBOURNE, FLA.
Digital imagery test set
[AD-A049798] N78-21825

HARVARD RADIO ASTRONOMY STATION, FORT DAVIS, TEX.
Experimental solar radio spectrum analyzer [50-100 MHz]
[NASA-CR-156079] N78-22012

HARVARD UNIV., CAMBRIDGE, MASS.
Nonequilibrium properties of variable-thickness superconducting micro-bridges
[AD-A049779] N78-21381
Broadness of optical impurity spectra in the solid state
N78-21899
The structure of the solar transition region and inner corona
N78-22011
HARVEY MUDD COLL., CLAREMONT, CALIF.
Generation of a monodispersed aerosol
[NASA-CR-152133] N78-21445
HAWAII UNIV., HONOLULU.
Pressure dependence of the elastic moduli of body-centered-cubic transition metals
N78-21943
HEALTH EDUCATION AUTHORITY OF LOUISIANA, NEW ORLEANS.
Grid-connected ICES preliminary feasibility analysis and evaluation. Volume 1: Executive summary
[COO/4214-1/1-VOL-1] N78-21641
HINDUSTAN AERONAUTICS LTD., BANGALORE [INDIA].
Multi-variate optimization problems of flight vehicle synthesis
[PB-276123/7] N78-21103
HONEYWELL, INC., MINNEAPOLIS, MINN.
Automated image enhancement techniques for second generation FLIR
[AD-A049564] N78-21913
HONEYWELL CORPORATE MATERIAL SCIENCES CENTER, BLOOMINGTON, MINN.
An investigation of laser interactions
[AD-A050049] N78-21460
HOUSTON CHEMICAL CO., CORPUS CHRISTI, TEX.
Solar heat transport fluid
[NASA-CR-150612] N78-21592
HOUSTON UNIV., TEX.
Low profile, printed circuit antennas
[AD-A047629] N78-21389
On Nth roots of positive operators
[NASA-CR-151697] N78-21841
The numerical evaluation of maximum-likelihood estimates of the parameters for a mixture of normal distributions from partially identified samples
[NASA-CR-151699] N78-21842
Morphology of design of aerospace systems with inclusion of human factors
[AD-A049999] N78-21973
HUGHES AIRCRAFT CO., LOS ANGELES, CALIF.
Severe storms observing satellite [STORMSAT]
[NASA-CR-156735] N78-21720
HUGHES RESEARCH LABS., MALIBU, CALIF.
Unstructured control and communication processes in real world scene analysis
[AD-A049458] N78-21352
Optical-microwave interactions in semiconductor devices
[AD-A050480] N78-21458
Diffusion process for formation of single-mode waveguide
[AD-A049558] N78-21915
HYPERFINE, INC., FAIRPORT, N.Y.
Research directed toward improved echelles for the ultraviolet
[NASA-CR-156732] N78-21427

I

IBM FEDERAL SYSTEMS DIV., HUNTSVILLE, ALA.
System design package for IBM system one: solar heating and domestic hot water
[NASA-CR-150614] N78-21589
System design package for solar heating and cooling site data acquisition subsystem
[NASA-CR-150606] N78-21593
Systems integration of marketable subsystems: A collection of progress reports
[NASA-CR-150587] N78-21594
Central Data Processing System [CDPS] user's manual: Solar heating and cooling program
[NASA-CR-150580] N78-21595
IIT RESEARCH INST., CHICAGO, ILL.
Initiation mechanisms of solid rocket propellant detonation
[AD-A049531] N78-21305
Atmospheric scavenging of solid rocket exhaust effluents
[NASA-CR-2997] N78-21665
ILLINOIS INST. OF TECH., CHICAGO.
Analysis of temperature compensating circuits for hot-wires and hot-films
[AD-A050080] N78-21432
Design of interactive manufacturing and quality systems subject to inspection error using dynamic programming
N78-21481
The stress clock function in viscoelasticity
N78-21486
Generation and detection of microwave phonons in N-type indium antimonide
N76-21945
ILLINOIS UNIV. AT CHICAGO CIRCLE, CHICAGO.
Heat transfer in continuum and rarefied gases
N78-21399
Asymptotically derived cylindrical shell theories with application to anisotropic composite materials
N78-21488
Experimental and theoretical studies of ion-molecule scattering
N78-21898
ILLINOIS UNIV. AT URBANA-CHAMPAIGN, SAVOY.
How big the moon, how fat the eye?
[AD-A050211] N78-21756
Evaluation of the transfer and cost effectiveness of a complex computer-assisted flight procedure trainer
[AD-A050413] N78-21764
Adaptive training of perceptual motor skills: Issues, results and future directions
[AD-A050461] N78-21765
Human performance in aviation systems
[AD-A050078] N78-21771
ILLINOIS UNIV., URBANA.
Speckle noise in satellite based lidar systems
[NASA-CR-156723] N78-21444
ILLINOIS UNIV., URBANA-CHAMPAIGN.
A fully automated system for pulsed NMR measurements
N78-21228
Pitting in aluminum
[AD-A049854] N78-21274
Structure and deformation characteristics of rheocast metals
[AD-A049975] N78-21279
Modeling of convective mode combustion through granulated propellant to predict transition to detonation
[AD-A049499] N78-21302
Efficient computation of radiation patterns and contour beam synthesis using reflector antennas
[AD-A050132] N78-21361
Electron beam addressed arrays of infrared bolometers
[AD-A049550] N78-21905
IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON [ENGLAND].
A comparison between predicted and measured species concentrations and velocities in a research combustor
N78-21158
INDIANA UNIV., BLOOMINGTON.
Systems of generalized Abel integral equations
[AD-A050001] N78-21857
INSTITUT FRANCO-ALLEMAND DE RECHERCHES, ST. LOUIS [FRANCE].
Transmission of impulse noise to the inner ear in the guinea pig by the recording of the intracochlear pressure. Evaluation of phenomena leading to injuries
[ISL-R-103/77] N78-21749
INSTITUTE FOR DEFENSE ANALYSES, ARLINGTON, VA.
Cost-effectiveness of flight simulators for military training. Volume 2: Estimating costs of training in simulators and aircraft
[AD-A049979] N78-21168
INSTITUTE FOR ENERGY ANALYSIS, OAK RIDGE, TENN.
Thermodynamics and energy policy
[ORAU-IEA-M-77-18] N78-21643
Net energy analysis of an Ocean Thermal Energy Conversion [OTEC] system
[ORAU/IEA[M]-77-1] N78-21652
Net energy from municipal solid waste
[ORAU/IEA[M]-77-5] N78-21653
INSTITUTO DE PESQUISAS ESPACIAIS, SAO JOSE DOS CAMPOS [BRAZIL].
Study of soft alkaline using LANDSAT images of pools and residue with an emphasis on radioactive materials
[E78-10104] N78-21510
Study of vertical movement and associative precipitation by extratropical perturbations in South America
[E78-10107] N78-21513
Remote sensing applied to geological mapping; comparative geomorphology and identification of mineral zones of zinc and lead in the region of Vazante, MG
[E78-10108] N78-21514
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[PB-276486/8] N78-21746

J

JAPAN BROADCASTING CORP., TOKYO.
Multichannel still-picture transmission system: TDM transmission of delta-M sounds with still-picture in television channel
[NHK-LABS-NOTE-214] N78-21330
Miniature stereomicrophone
[NHK-LABS-NOTE-213] N78-21331
JAYCOR, DEL MAR, CALIF.
Numerical calculation of the stability of parallel flows
[AD-A049983] N78-21418
JET PROPULSION LAB., CALIF. INST. OF TECH., PASADENA.
Compilation of wind tunnel coefficients for parabolic reflectors
[NASA-CR-156161] N78-21057
An interstellar precursor mission
[NASA-CR-156152] N78-21173
Large active retrodirective arrays for space applications
[NASA-CR-156163] N78-21333
Geologic application of thermal inertia imaging using HCMM data
[E78-10119] N78-21523
Evaluation of LANDSAT MSS vs TM simulated data for distinguishing hydrothermal alteration
[NASA-CR-156168] N78-21569
Results of the 1974 through 1977 NASA/JPL balloon flight solar cell calibration program
[NASA-CR-156180] N78-21598
Small Power Systems Solar Electric Workshop Proceedings. Volume 1: Executive report. Volume 2: Invited papers
[NASA-CR-156165] N78-21599
Structure of deformed silicon and implications for low cost solar cells
[NASA-CR-156166] N78-21600
Characterization of solar cells for space applications. Volume 1: Electrical characteristics of OCLI violet solar cells as a function of intensity and temperature
[NASA-CR-156162] N78-21601
An assessment of an F2 or N2O4 atmospheric injection from an aborted space shuttle mission
[NASA-CR-156164] N78-21664
JOINT CENTER FOR GRADUATE STUDY, RICHLAND, WASH.
Space electric power design study
[NASA-CR-152031] N78-21590
JOINT CONVENTIONAL AMMUNITION PROGRAM COORDINATING GROUP, ROCK ISLAND, ILL.
Performance predictors for value engineering program management
[AD-A049696] N78-21972
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Translations on USSR science and technology: Physical sciences and technology, no. 33
[JPRS-70946] N78-21183
A runaway satellite is going to crash 20 April
N78-21184
Laboratory in space
N78-21185
Translations on USSR science and technology: Biomedical and behavioral sciences, no. 24
[JPRS-70928] N78-21761
Cosmonaut work capacity in flight
N78-21762
Some problems in assessing oculomotor activity during information retrieval
N78-21763
JTIDS PROGRAM OFFICE, HANSCOM AFB, MASS.
The Joint Tactical Information Distribution System [JTIDS]
N78-21086

K

KANSAS STATE UNIV., MANHATTAN.
Application of wheat yield model to United States and India
[E78-10109] N78-21515
Estimated winter wheat yield from crop growth predicted by LANDSAT
[E78-10112] N78-21517
KANSAS UNIV., LAWRENCE.
Stochastic filtering and control
[AD-A049992] N78-21829
KANSAS UNIV. CENTER FOR RESEARCH, INC., LAWRENCE.
Experimental and theoretical sound transmission
[NASA-CR-156170] N78-21889
KENT STATE UNIV., OHIO.
Averaging in Banach spaces
N78-21887
KERR [ROBERT S.] ENVIRONMENTAL RESEARCH LAB., ADA, OKLA.
Thermocouple readout instrument
[PB-275429/9] N78-21436

L

LEAR SIEGLER, INC., GRAND RAPIDS, MICH.
A multi-sensor implementation for navigation, position location, position update, reconnaissance, and weapon delivery: AN/ARN-101[V]
N78-21082

LIEGE UNIV. [BELGIUM].
Finite element analysis of some problems arising in cooled turbine blades
N78-21144

LIFE SCIENCES ENGINEERING, MORRISON, COLO.
Subsystem design package for Solar II collector
[NASA-CR-150611] N78-21602

LIFE SYSTEMS, INC., CLEVELAND, OHIO.
Advanced solid electrolyte cell for CO2 and H2O electrolysis
[NASA-CR-152093] N78-21235

LINCOLN LAB., MASS. INST. OF TECH., LEXINGTON.
Orbit prediction errors resulting from vertical misalignment of a radar antenna
[AD-A050161] N78-21186
Analysis of distributed-emission crossed-field amplifiers
[AD-A050185] N78-21391
Distributed sensor networks
[AD-A050160] N78-21576
Real-time, intermediate-field astrometry
[AD-A048155] N78-22001

LITTLE [ARTHUR D.], INC., CAMBRIDGE, MASS.
Theoretical study to determine the sea state limit for the survival of oil slicks on the ocean
[AD-A049794] N78-21666

LITTON INDUSTRIES, MORRIS PLAINS, N.J.
Preparation of rare earth doped laser materials
[AD-A049697] N78-21454

LOCKHEED-CALIFORNIA CO., BURBANK.
Fuel conservation merits of advanced turboprop transport aircraft
[NASA-CR-152096] N78-21095

LOCKHEED ELECTRONICS CO., HOUSTON, TEX.
Orbiter S-band FM system console test procedure
[NASA-CR-151694] N78-21338
A model of the 0.4-GHz scatterometer
[NASA-CR-151693] N78-21574

LOCKHEED MISSILES AND SPACE CO., PALO ALTO, CALIF.
Division 2: Materials in space engineering. Chapter 3: Influence of the space medium on materials
N78-21178
Complex loading of a composite material with a plastic matrix by torsion and tension
N78-21222
On the question of the fracture mechanism for solid polymers
N78-21290
Description of the temperature dependence of viscoelastic properties of polymers in the dynamic mode on the basis of linear thermoviscoelasticity theory
N78-21291
Certain results of determining the temperature dependences of the thermophysical characteristics of composite polymers
N78-21292
Stress relaxation in physically nonlinear polymer materials under combined tension with torsion
N78-21293
Experimental study of the initiation mechanism of laser supported absorption waves
[AD-A050054] N78-21461
On the question of equivalent reinforcement of holes in a shell
N78-21496
Use of the method of one-dimensional nonlinear transformations to forecast the natural model of an oil stratum
N78-21693
Statistical analysis of a forecasting model using one-dimensional nonlinear transformations
N78-21843

LOS ALAMOS SCIENTIFIC LAB., N. MEX.
Effect of attitude control thruster induced structural vibrations on sensed accelerations of a space vehicle
[LA-6965-MS] N78-21201
Petrography and geochemistry of Precambrian rocks from GT-2 and EE-1
[LA-6930-MS] N78-21709
Scientific calculating system with a number-oriented microprocessor sequenced by a single component microcomputer
[LA-UR-2383] N78-21789
General-purpose heat source project, space nuclear safety program, and radioisotopic terrestrial safety program
[LA-7003-PR] N78-21906
High-resolution spectroscopy using tunable diode lasers: Techniques and applications
[LA-UR-77-2222] N78-21917

LUCAS AEROSPACE LTD., BURNLEY [ENGLAND].
Practical solutions to the cooling of combustors operating at high temperatures
N78-21135
Evaluation of a ceramic combustion chamber for a small gas turbine engine
N78-21145

LUMMUS CO., BLOOMFIELD, N. J.
Prototype pilot plant operation, synthane process
[COO-0003-10] N78-21317

LUMMUS CO., NEW YORK.
Prototype pilot plant operation: Synthane process
[COO-0003-8] N78-21316

LUNAR SCIENCE INST., HOUSTON, TEX.
Utilization of lunar materials and expertise for large scale operations in space: Abstracts
[NASA-CR-156167] N78-21180

M

MAINE UNIV., ORONO.
Internal reflection of bounded beams: Effects in the plane of incidence
N78-21910

MAN-ACOUSTICS AND NOISE, INC., SEATTLE, WASH.
Response to actual and simulated recordings of conventional takeoff and landing jet aircraft
[NASA-CR-145318] N78-21890

MARTIN MARIETTA AEROSPACE, DENVER, COLO.
Shuttle orbiter - IUS/DSP satellite interface contamination study
[NASA-CR-151682] N78-21197

MARTIN MARIETTA AEROSPACE, ORLANDO, FLA.
Quantification of printed circuit board [PCB] connector reliability
[AD-A049980] N78-21378

MARTIN MARIETTA CORP., DENVER, COLO.
Analysis and test for space shuttle propellant dynamics: 1/60th scale model test results
[NASA-CR-151681] N78-21301
Thermal radiation analysis system [TRASYS 2], programmer's manual
[NASA-CR-151686] N78-21792

MARTIN MARIETTA LABS., BALTIMORE, MD.
Combustion properties of high density fuels
[AD-A050051] N78-21310
Internal gravity wave generation by vortex wakes
[AD-A049515] N78-21699

MARYLAND DEPT. OF HEALTH AND MENTAL HYGIENE, BALTIMORE.
Water quality and shellfish sanitation
N78-21550

MARYLAND DEPT. OF STATE PLANNING, BALTIMORE.
Maryland Automated Geographic Information System
N78-21534

MARYLAND GEOLOGICAL SURVEY, BALTIMORE.
Remote sensing, geology, and land use
N78-21533

MARYLAND UNIV., CAMBRIDGE.
On measuring the state of the bay
N78-21537

MARYLAND UNIV., COLLEGE PARK.
Mission of a remote sensing center
N78-21536
Lidar: A laser technique for remote sensing
N78-21549
Modeling of Rankine cycle/vapor compression cycle cooling systems for solar energy applications
N78-21587
Crustal evolution in the early earth: Basin-forming impacts, crustal dichotomy, and plate tectonics
N78-21685
PDP 11 image processing software
[AD-A049586] N78-21799
Thinning algorithms for grayscale pictures
[AD-A049587] N78-21800
Iterative histogram modification, 2
[AD-A049588] N78-21801
A note on the use of local MIN and MAX operations in digital picture processing
[AD-A049589] N78-21802
Algorithms and hardware technology image recognition
[AD-A049590] N78-21803
A note on the use of second-order gray level statistics for threshold selection
[AD-A049454] N78-21820
Clustering edge values for threshold selection
[AD-A049592] N78-21823
Mosaic models for image analysis and synthesis
[AD-A050100] N78-21826
Reduction of a large polynomial matrix to Smith-normal-form by unimodular block-partitioning transformation
[AD-A049453] N78-21845
A study of the propagation and intrinsic characteristics of flare-associated particle events
N78-22010

MARYLAND UNIV., FROSTBURG.
Use of remote sensing technology provided by the NASA/WFC Chesapeake Bay Ecological Program
N78-21538

MARYLAND UNIV., PRINCE FREDERICK.
Regional energetic coupling of man and his environment: Data requirements
N78-21543

MARYLAND UNIV., SOLOMONS.
Eutrophication in the Chesapeake Bay
N78-21551

MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION, SILVER SPRING, MD.
Application of a computerized environmental information system to master and sector planning
N78-21561

MASON AND HANGER-SILAS MASON CO., INC., AMARILLO, TEX.
Small inner spherical radius sweep gage
[MHSMP-77-5G] N78-21434

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Nitric oxide formation in gas turbine engines: A theoretical and experimental study
[NASA-CR-2977] N78-21116
Systematic studies of heat transfer and film cooling effectiveness
N78-21146
A satellite control problem
[AD-A049510] N78-21194
A general approach for kinematic waves
[AD-A050077] N78-21367
Fundamental mechanisms of nonequilibrium MHD lasing phenomena
[AD-A049509] N78-21447
Study of surface fatigue wear by exoelectron emission
[AD-A049927] N78-21476
Analytical models and experimental studies of centrifugal pump performance in two-phase flow. Key phase report
[EPRI-NP-170] N78-21477
Completing the requirements set as a means towards better design frameworks: A follow-up exercise in software architectural design
[AD-A049782] N78-21787
Design of a compensation for an ARMA model of a discrete time system
[NASA-CR-156097] N78-21838
Approximate solutions for certain optimal stopping problems
[AD-A049995] N78-21856
Approximate solutions for certain optimal stopping problems
[AD-A049556] N78-21878

MASSACHUSETTS UNIV., AMHERST.
X-ray diffraction studies of helium four
N78-21226

MATERIALS RESEARCH LABS., MELBOURNE [AUSTRALIA].
Antifouling activity of phytotoxic compounds and experimental polymeric algicides
[MRL-R-698] N78-21747

MATERIALS SCIENCES CORP., BLUE BELL, PA.
Evaluation and expansion of an analytical model for fatigue of notched composite laminates
[NASA-CR-145308] N78-21219

MATHEMATICAL SCIENCES NORTHWEST, INC., BELLEVUE, WASH.
High thermal efficiency, radiation-based advanced fusion reactors
[EPRI-ER-544] N78-21926

MAYO FOUNDATION, ROCHESTER, MINN.
Protection of the cardiopulmonary systems against the injurious effects of acceleration
[AD-A050142] N78-21755

MCDONNELL AIRCRAFT CO., ST. LOUIS, MO.
Multiband antenna system for tactical aircraft
[AD-A049699] N78-21363

MCDONNELL-DOUGLAS ASTRONAUTICS CO., ST. LOUIS, MO.
Synthesis and analysis of precise spaceborne laser ranging systems, volume 1
[NASA-CR-156727] N78-21442
Synthesis and analysis of precise spaceborne laser ranging systems, volume 2
[NASA-CR-156728] N78-21443

MCDONNELL-DOUGLAS CORP., LONG BEACH, CALIF.
A three-dimensional potential-flow program with a geometry package for input data generation
[NASA-CR-145311] N78-21047

MCDONNELL-DOUGLAS CORP., ST. LOUIS, MO.
HF radiation characteristics of the RH-53D helicopter and the Mark 105 AMCM system
[AD-A049795] N78-21358

MCMATH-HULBERT OBSERVATORY, PONTIAC, MICH.
Survey and comparison of solar activity and energetic particle emission in 1970
[AD-A048479] N78-22013

MECHANICAL TECHNOLOGY, INC., LATHAM, N. Y.
Hydrodynamic air lubricated compliant surface bearing for an automotive gas turbine engine. 1: Journal bearing performance
[NASA-CR-135368] N78-21472

MEDICAL COLL. OF VIRGINIA, RICHMOND.
Biological applications and effects of optical masers
[AD-A050057] N78-21462

MESSERSCHMITT-BOELKOW-BLOHM G.M.B.H., MUNICH [WEST GERMANY].
Development of the integrated all-weather navigation system for tornado [MRCA] N78-21089
METEOROLOGY RESEARCH, INC., ALTADENA, CALIF.
Century industrial products FRP-100 wet scrubber evaluation
[PB-276520/4] N78-21680
MICHIGAN UNIV., ANN ARBOR.
System optimization by periodic control
[AD-A049522] N78-21162
Definition of tire properties required for landing system analysis
[NASA-CR-156171] N78-21326
APL radiometer wind tunnel test program
[BSR-4188] N78-21401
APL radiometer wind tunnel test program with simulated aircraft radome
[BSR-4230] N78-21402
Lightweight, low compression aircraft diesel engine
[NASA-CR-135300] N78-21471
MIDDLE EAST TECHNICAL UNIV., ANKARA [TURKEY].
Erosion prevention and film cooling on vanes N78-21128
MINNESOTA UNIV., MINNEAPOLIS.
Grid-connected integrated community energy system, executive summary, phase 1
[COO/4210-1-SUMM] N78-21638
Simulation studies on some nearest neighbor rules for statistical classification
[AD-A049548] N78-21877
Laboratory simulation of infrared astrophysical features N78-21998
MISSISSIPPI STATE UNIV., MISSISSIPPI STATE.
Mixed-mode fracture of graphite/epoxy composites
[AD-A049528] N78-21224
A study of the waveguide mode excitation and propagation in a parallel plate transmission line
[AD-A050118] N78-21360
MISSISSIPPI STATE UNIV., STATE COLLEGE.
Elliptic systems and numerical transformations
[NASA-TM-79433] N78-21840
MISSISSIPPI UNIV., UNIVERSITY.
Small aperture on a multiconductor transmission line filled with inhomogeneous dielectrics
[AD-A050099] N78-21359
MISSOURI UNIV., ROLLA.
Signal-to-noise ratio estimation in digital computer simulation of lowpass and bandpass systems with applications to analog and digital communications N78-21329
MITRE CORP., MCLEAN, VA.
Alaskan oil transportation issues
[PB-276449/6] N78-21661
MOTOREN- UND TURBINEN-UNION MUENCHEN G.M.B.H. [WEST GERMANY].
Technical evaluation report on 50th Propulsion and Energetics Panel Meeting on High Temperature Problems in Gas Turbine Engines N78-21119
Hot cascade test results of cooled turbine blades and their application to actual engine conditions N78-21125
MOTOROLA, INC., SCOTTSDALE, ARIZ.
Monolithic surface wave transversal filter
[AD-A049938] N78-21385

N

NATIONAAL LUCHT-EN RUIMTEVAARTLABORATORIUM, AMSTERDAM [NETHERLANDS].
Environmental effects on crack growth in flight-simulation tests on 2024-T3 and 7075-T6 material
[NLR-TR-76104-U] N78-21492
NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL, WASHINGTON, D. C.
Helium: A public policy problem
[PB-276040/3] N78-21585
The quality of NOAA's ocean research and development program: An evaluation
[PB-277095/6] N78-21980
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D. C.
Airfoil profile in a nonuniform flow
[NASA-TM-75272] N78-21048
Germination of pine seed in weightlessness [investigation in Kosmos 782]
[NASA-TM-75281] N78-21172
Apollo over the moon: A view from orbit
[NASA-SP-362] N78-21174
Space orbits of collaboration
[NASA-TM-75096] N78-21176
Tsiolkovsky's Ideas on Cosmonautic Problems
[NASA-TT-F-16118] N78-21177
Heat Capacity Mapping Mission [HCMM] launch
[NASA-TM-79429] N78-21191
Biological satellite Kosmos-936
[NASA-TM-75097] N78-21192
Mathematical simulation of power conditioning systems. Volume 1: Simulation of elementary units. Report on simulation methodology
[NASA-TM-75209] N78-21212
Activation analysis of admixtures in certain semiconductive materials
[NASA-TM-75258] N78-21231
Temperature profile of graphite surface burning in a stream of oxygen
[NASA-TM-75271] N78-21232
Investigation of the turbulent flows of two-phase media
[NASA-TT-F-17059] N78-21408
Problems of hydrodynamics and heat exchange
[NASA-TT-F-17060] N78-21409
Flow of viscous gas in the region of a slot with strong suction
[NASA-TM-75241] N78-21411
Experimental study of the laminar-turbulent transition of a concave wall in a parallel flow
[NASA-TM-75243] N78-21412
The execution of systematic measurements on plane cascades
[NASA-TM-75278] N78-21413
HCMM satellite to take earth's temperature
[NASA-NEWS-RELEASE-78-60] N78-21507
LANCHAD: Remote sensing of the N'Djamena area and the Logone-Chari confluent
[NASA-TM-75087] N78-21570
Metric remote sensing experiments in preparation for Spacelab flights
[NASA-TM-75093] N78-21571
Use of satellite images in the evaluation of farmlands
[NASA-TM-75088] N78-21575
Space solar power. Description of concept, results of preliminary studies, requirements for evaluation
[NASA-TM-79436] N78-21611
Aerospace Medicine and Biology: A continuing bibliography with indexes, supplement 178
[NASA-SP-7011(178)] N78-21750
Working in a hot environment; perspiration loss; a drink for persons working under hot conditions, part 2
[NASA-TM-75285] N78-21751
Study of diatomic molecules. 2: Intensities
[NASA-TM-75290] N78-21900
Determination of boron and lithium by recording the products from [n, alpha] reactions
[NASA-TM-75260] N78-21904
Novel silicon crystals and method for their preparation
[NASA-TM-75195] N78-21957
The superconductivity of certain ternary molybdenum compounds
[NASA-TM-75250] N78-21958
Applications notice
[AN-OSTA-78-A] N78-21991
Standard techniques for presentation and analysis of crater size-frequency data
[NASA-TM-79730] N78-22006
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. AMES RESEARCH CENTER, MOFFETT FIELD, CALIF.
Effect of high lift flap systems on the conceptual design of a 1985 short-haul commercial STOL tilt rotor transport
[NASA-TM-78474] N78-21094
A note on multicyclic control by swashplate oscillation
[NASA-TM-78475] N78-21159
Theoretical contamination of cryogenic satellite telescopes
[NASA-TP-1177] N78-21193
Fire resistivity and toxicity studies of candidate aircraft passenger seat materials
[NASA-TM-78468] N78-21214
Calculated rate constants for the reaction ClO + O yields Cl + O2 between 220 and 1000 deg K
[NASA-TM-78483] N78-21215
On the period of the coherent structure in boundary layers at large Reynolds numbers
[NASA-TM-78477] N78-21407
Simple torsion test for shear moduli determination of orthotropic composites
[NASA-TM-78485] N78-21490
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. HUGH L. DRYDEN FLIGHT RESEARCH CENTER, EDWARDS, CALIF.
Results from flight and simulator studies of a Mach 3 cruise longitudinal autopilot
[NASA-TP-1180] N78-21160
An efficient algorithm for choosing the degree of a polynomial to approximate discrete nonoscillatory data
[NASA-TM-72854] N78-21839
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.
The N-BOD2 user's and programmer's manual
[NASA-TP-1145] N78-21200
Formulation of electrically conductive thermal-control coatings
[NASA-TP-1218] N78-21216
Application of Remote Sensing to the Chesapeake Bay Region. Volume 2: Proceedings
[NASA-CP-6] N78-21526
Present status of LANDSAT remote sensing N78-21529
LANDSAT sensors N78-21540
Remote in-situ elemental analysis systems for underwater application N78-21546
Contribution of remote sensing to understand the Bay as a system N78-21553
Role of remote sensing in documenting living resources N78-21554
Use of remote sensing in facility siting N78-21555
Role of remote sensing in documenting land use as it affects the Bay and Bay use as it affects the land N78-21556
Role of remote sensing in Bay measurements N78-21557
Possible role of remote sensing for increasing public awareness of the Chesapeake Bay environment N78-21558
Microwave emission from polar firn
[NASA-TP-1212] N78-21690
On the tidal oscillations of the liquid core of the earth
[NASA-TP-1223] N78-21691
User's guide to the Nimbus-4 backscatter ultraviolet experiment data sets
[NASA-TM-78069] N78-21694
On the average configuration of the geomagnetic tail
[NASA-TM-78116] N78-21695
Gamma-ray astronomy and the origin of cosmic rays
[NASA-TM-79535] N78-22017
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LYNDON B. JOHNSON SPACE CENTER, HOUSTON, TEX.
Construction in space: A proposed experiment in support of the space solar power concept and other large space systems
[NASA-TM-79435] N78-21179
Active Microwave Users Workshop Report
[NASA-CP-2030] N78-21562
Summary of the active microwave users workshop N78-21563
Applications of active microwave imagery N78-21564
Seasat land experiments N78-21565
Active microwave users working group program planning N78-21566
Synthetic Aperture Radar [SAR] data processing N78-21567
The use of LANDSAT digital data and computer-implemented techniques for an agricultural application
[NASA-RP-1016] N78-21568
Solar power satellites
[NASA-TM-79434] N78-21612
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LANGLEY RESEARCH CENTER, LANGLEY STATION, VA.
Subsonic longitudinal and lateral-directional static aerodynamic characteristics for a close-coupled wing-canard model in both swept back and swept forward configurations
[NASA-TM-74092] N78-21049
A vectorization of the Jameson-Caughey NYU transonic swept-wing computer program FLO-22-V1 for the STAR-100 computer
[NASA-TM-78665] N78-21050
Effect of leading-edge contour and vertical-tail configuration on the low-speed stability characteristics of a supersonic transport model having a highly-swept arrow wing
[NASA-TM-78683] N78-21051
Comparison of aerodynamic data measured in air and Freon-12 wind-tunnel test mediums
[NASA-TM-78671] N78-21052
Numerical study of transonic flow over oscillating airfoils using the full potential equation
[NASA-TP-1120] N78-21055
Flow field visualization about external axial corners
[NASA-TM-78682] N78-21056
Results of a simulator test comparing two display concepts for piloted flight-path-angle control
[NASA-TM-78692] N78-21104
Rectangular capture area to circular combustor scramjet engine
[NASA-TM-78657] N78-21107
Flow visualization of film cooling with spanwise injection from a small array of holes and compound-angle injection from a large array
[NASA-TP-1195] N78-21113
Correlation of laser velocimeter measurements over a wing with results of two prediction techniques
[NASA-TP-1168] N78-21410
A method of calibrating wind velocity sensors with a modified gas flow calibrator
[NASA-TM-78707] N78-21426
A small gas inlet system for orbital mass-spectrometer calibrations
[NASA-TP-1170] N78-21430

A feasibility study of ion implantation techniques for mass spectrometer calibration
[NASA-TP-1185] N78-21431
A biaxial method for inplane shear testing
[NASA-TM-74070] N78-21489

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Comparison of the noise characteristics of two low pressure ratio fans with a high throat Mach number inlet
[NASA-TM-73880] N78-21108
Gas path sealing in turbine engines
[NASA-TM-73890] N78-21109
Photographic characterization of spark-ignition engine fuel injectors
[NASA-TM-78830] N78-21110
Airflow and thrust calibration of an F100 engine, S/N P680059, at selected flight conditions
[NASA-TP-1069] N78-21112
Theoretical flow characteristics of inlets for tilting-nacelle VTOL aircraft
[NASA-TP-1205] N78-21114
Progress in advanced high temperature turbine materials, coatings, and technology
N78-21122
The Plasma Interaction Experiment [PIX] description and test program
[NASA-TM-78863] N78-21188
Comparison of reusable insulation systems for cryogenically-tanked earth-based space vehicles
[NASA-TM-73668] N78-21190
Charging of flexible solar array substrates in kilovolt electron beams
[NASA-TM-73865] N78-21199
Evolution of the 1-mlb mercury ion thruster subsystem
[NASA-TM-73733] N78-21202
Pulse ignition characterization of mercury ion thruster hollow cathode using an improved pulse igniter
[NASA-TM-78858] N78-21203
Planned flight test of a mercury ion auxiliary propulsion system. 1: Objectives, systems descriptions, and mission operations
[NASA-TM-78859] N78-21204
Effect of facility background gases on internal erosion of the 30-cm Hg ion thruster
[NASA-TM-73803] N78-21205
A review of electron bombardment thruster systems/spacecraft field and particle interfaces
[NASA-TM-78850] N78-21206
Diagnostic evaluations of a beam-shielded 8-cm mercury ion thruster
[NASA-TM-78855] N78-21207
The 5200 cycle test of an 8-cm diameter Hg ion thruster
[NASA-TM-78860] N78-21208
Planned flight test of a mercury ion auxiliary propulsion system. Part 2: Integration with host spacecraft
[NASA-TM-78869] N78-21209
Liquid rocket engine self-cooled combustion chambers
[NASA-SP-8124] N78-21211
In situ ply strength: An initial assessment
[NASA-TM-73771] N78-21220
Titanium/beryllium laminates: Fabrication, mechanical properties, and potential aerospace applications
[NASA-TM-73891] N78-21221
Strength enhancement process for prealloyed powder superalloys
[NASA-TM-78834] N78-21266
Strainrange partitioning behavior of the nickel-base superalloys, Rene' 80 and in 100
[NASA-TM-78828] N78-21267
Influence of fretting on flexural fatigue of 304 stainless steel and mild steel
[NASA-TP-1193] N78-21269
Friction and metal transfer for single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1191] N78-21294
Wear of single-crystal silicon carbide in contact with various metals in vacuum
[NASA-TP-1198] N78-21295
NASA charging analyzer program: A computer tool that can evaluate electrostatic contamination
[NASA-TM-73889] N78-21372
Investigation of high voltage spacecraft system interactions with plasma environments
[NASA-TM-78831] N78-21373
Constrained sloshing of liquid mercury in a flexible spherical tank
[NASA-TM-78833] N78-21403
Boundary layer analysis of a Centaur standard shroud
[NASA-TM-78843] N78-21404
A review of the thermoelectronic laser energy converter [TELEC] program at Lewis Research Center
[NASA-TM-73888] N78-21441
Characterization of wear debris generated in accelerated rolling-element fatigue tests
[NASA-TP-1203] N78-21470
Rolling-element fatigue life of AISI M-50 and 18-4-1 balls
[NASA-TP-1202] N78-21473
Effluent characterization from a conical pressurized fluid bed
[NASA-TM-73897] N78-21596
FLOWNET: A computer program for calculating secondary flow conditions in a network of turbomachinery
[NASA-TM-73774] N78-21791
Effect of anode-cathode geometry on performance of the HIP-1 hot ion plasma
[NASA-TP-1201] N78-21922

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.

Space Processing Applications Rocket project SPAR III
[NASA-TM-78137] N78-21189
Simplified model of statistically stationary spacecraft rotation and associated induced gravity environments
[NASA-TM-78164] N78-21198
Shear strength of fillet welds in aluminum alloy 2219
[NASA-TM-78168] N78-21495
Owens-Illinois liquid solar collector materials assessment
[NASA-TM-78163] N78-21597
Use of the Marshall Space Flight Center solar simulator in collector performance evaluation
[NASA-TM-78165] N78-21605

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. WALLOPS STATION, WALLOPS ISLAND, VA.

Remote sensing of Gulf Stream using GEOS-3 radar altimeter
[NASA-TP-1209] N78-21737

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Time-dependent fire behavior of aircraft cabin materials
[AD-A050923] N78-21234
Ultraviolet photoemission studies of formaldehyde and related molecules absorbed on Ru[110]
[AD-A049661] N78-21239
Erosion of brittle materials by solid particle impact
[AD-A050252] N78-21296
Performances assurance and data integrity practices
[PB-276400/9] N78-21819

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[PB-275786/2] N78-21987

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N78-21559

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[CONF-770632] N78-21644

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Remote sensing of water quality
N78-21541
Lake Erie ice: Winter 1975 - 1976
[PB-276386/0] N78-21584
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[PB-277102/0] N78-21732

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N78-21131

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The automotive fuel economy standards for model year 1981-1984 passenger cars
[PB-275827/4] N78-21314
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[PB-275895/1] N78-21315

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[PB-276429/8] N78-21106
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[PB-277100/4] N78-21312
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[PB-277103/8] N78-21421
A division of the aa indices into six classes based on the Ap' index, 1868-1976
[PB-276388/6] N78-21708
USMR [White Sands Missile Range] atmospheric structure constant [C sub n, sup 2] survey
[PB-276097/3] N78-21711
A method for assessment of the natural variability found in hurricanes through use of ranking techniques and nonparametric statistics
[PB-276430/6] N78-21733

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N78-21542

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[PB-277104/6] N78-21506
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[PB-275391/1] N78-21674
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[NTSB-AAS-78-1] N78-21063
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[AD-A050164] N78-21100

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[AD-A049778] N78-21702

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A life cycle cost study of contractor versus organic support of aircraft programs
[AD-A049438] N78-21045
Unsteady, surface pressure and near-wave hotwire measurements of a circulation control airfoil
[AD-A050025] N78-21061
Report on aircraft fatigue studies
[AD-A049876] N78-21102
A sub-scale turbojet test cell for design evaluations and analytical model validation
[AD-A049862] N78-21166
Effects of thermo-mechanical processing on aluminum-magnesium alloys containing high weight percentage magnesium
[AD-A050092] N78-21275
Design of two high gain, low profile helical antennas for operation at 918 MHz
[AD-A049950] N78-21386
Transverse oscillations of a circular cylinder in uniform flow, part 1
[AD-A049825] N78-21416
Experimental investigation of the effects of fluid loading on flexural waves in plates
[AD-A050020] N78-21417
The effect of modeling depth on reliability prediction for systems subject to a phased mission profile
[AD-A050246] N78-21482
Solar energy for the Naval Shore Establishment
[AD-A050026] N78-21616
Measurement of near sea surface turbulence and possible wave influence
[AD-A049951] N78-21704

Response of the upper ocean to Hurricane Eloise
[AD-A050245] N78-21722
A statistical study of synoptic storm activity over the North Pacific in 1975
[AD-A050052] N78-21729
Upper ocean thermal structure forecast evaluation of a model using synoptic data
[AD-A048526] N78-21739
Dynamical numerical prediction of large-scale thermal anomalies in the North Pacific Ocean
[AD-A049919] N78-21740
Multicriteria integer zero-one programming: A tree-search type algorithm
[AD-A050244] N78-21807
CMS histogram, density estimation and probability plotting routines, with an application to the analysis of the output of assimulation of a correlated queue
[AD-A050213] N78-21827
Sound transmission from a tapered fluid layer into a fast bottom
[AD-A050021] N78-21892

NAVAL RESEARCH LAB., WASHINGTON, D. C.
The use of halons as fire suppressants: A literature survey
[AD-A050098] N78-21237
Surface chemistry of fluoropolymer barrier films: Relation of solution variables to film properties
[AD-A050003] N78-21298
Range resolution of targets using automatic detectors
[AD-A049442] N78-21348
Calculation of optimum operating parameters for a gyrotron traveling wave amplifier
[AD-A049506] N78-21375
Measurement of the changes in dissipation factor and dielectric constant as a method of evaluating degradation in capacitor oils
[AD-A050004] N78-21380
Cryogenically-cooled microwave acoustic relay devices
[AD-A049765] N78-21382
Long-range holography field experiments
[AD-A050122] N78-21433
High energy ion expansion in laser-plasma interactions
[AD-A049504] N78-21446
Laser-fusion studies at NRL: A report to ERDA
[AD-A050089] N78-21451
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[AD-A050094] N78-21452
A preliminary study of aerosol initiated CO2 laser produced air sparks and their ability to guide electrical discharges
[AD-A050097] N78-21453
Transient response of two fluid-coupled spherical elastic shells to an incident pressure pulse
[AD-A049443] N78-21497
Comparison of the 3-5 micrometer and 8-12 micrometer regions for advanced thermal imaging systems: LOWTRAN revisited
[AD-A049448] N78-21697
High altitude limit of the gradient drift instability
[AD-A049503] N78-21698
Estimation of marine environmental parameters using microwave radiometric remote sensing systems
[AD-A049507] N78-21738
Algae, ultraviolet light, and the production of trace gases
[AD-A049441] N78-21748
A theory of electron energy confinement in Tokamaks
[AD-A049505] N78-21923
Ionization equilibrium and radiative energy loss rates for C, N, and O ions in low-density plasmas
[NASA-CR-156068] N78-21924
Axiomatic characterization of a family of information measures that contains the directed divergences
[AD-A050096] N78-21983

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[AD-A049620] N78-21060
Notes on data file exchange between the NRL TIASC and the DTNSRDC CDC-6616700
[AD-A049797] N78-21981

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[AD-A049973] N78-21169

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[AD-A049445] N78-21614

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[NASA-CR-2967] N78-21059

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N78-21397

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[AD-A049695] N78-21962

NORTHWESTERN UNIV., EVANSTON, ILL.
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[NASA-CR-152115] N78-21092
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N78-21259
An X-ray study of continuous ordering and its kinetics in binary alloys
N78-21260
Optimal control of a storage system
N78-21772
Multicriteria optimization with uncertainty in the dynamics
[AD-A049541] N78-21830
The Fermi surface of niobium
N78-21942

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N78-21952

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[CONF-770955-2] N78-21218
Composition of eta carbide in Hastelloy N after aging 10000 hr at 815 C
[ORNL-5340] N78-21283
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Loose-parts monitoring: Present status of the technology, its implementation in US reactors, and some recommendations for achieving improved performance
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Evaluation of flaw indications by ultrasonic pulse amplitude and phase spectroscopy
[ORNL-TR-4355] N78-21484
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[CONF-770870-1] N78-21647
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PLOT user's manual
[ORNL/CSD/TM-41] N78-21816
Study of possible separable solutions for plasma transport in ohmically heated Tokamaks
[ORNL/TM-6065] N78-21929
Effects of global field errors on ELMO Bumpy Torus
[ORNL/TM-6075] N78-21935
Analysis of Angular Dependent Auger Spectroscopy [ADAS] based on a quasiatomic model
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Effect of flux flow on self-field instability
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[Y/DA-7477] N78-21217

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N78-21139
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N78-21141
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N78-21151
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N78-21154

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A computer program for solving learning curve problems
[AD-A049917] N78-21812

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The influence of transpiration cooling on turbine blade boundary layer
N78-21130
Studies of transition metal analogs of hexaborane [10]. Nuclear magnetic resonance studies of heptaborane species
N78-21249
The exchange constant of germanium substituted yttrium iron garnet films
N78-21251
Alloy corrosion-fundamental studies of dissolution and passivity of alloys and compounds
[AD-A049848] N78-21273
An analysis of multi-frequency high resolution radar rain rate data
[NASA-CR-156734] N78-21337
Analysis of thin-wire antennas in the presence of a dielectric and/or ferrite inhomogeneity
[AD-A049455] N78-21350
The circumferential variation of the axial component of the current in closely spaced thin-wire antennas
[AD-A049456] N78-21351

OHIO UNIV., ATHENS.
The evaluation and energy propagation of relativistic electron-nucleus Bremsstrahlung and virtual photon spectra
N78-21895

OKLAHOMA STATE UNIV., STILLWATER.
A study of the field modulated generator system
N78-21371
Development of a unified approach to the simulation of static and dynamic behavior of large mobile hydraulic systems
N78-21395
Digital computer simulation of the mechanical and thermal response of complex hydraulic systems
N78-21396
A synthesis technique for the resolution of large scale fluid logic networks
N78-21400
Analytical determination of the Burmester lines for cylindric-cylindric cranks
N78-21465
Estimation and hypothesis testing for generalized multivariate analysis of covariance models
N78-21832
Randomized response designs
N78-21871
The measurement of cooperation and the determination of causal variables for cooperation in a technical environment
N78-21969

OKLAHOMA UNIV., NORMAN.
The modification and application of Kuo's parameterization of cumulus convection in middle latitudes
[NASA-CR-2998] N78-21717

OLD DOMINION UNIV., NORFOLK, VA.
Experimental investigation of effect of jet decay rate on jet-induced pressures on a flat plate
[NASA-CR-2979] N78-21096

OLD DOMINION UNIV. RESEARCH FOUNDATION, NORFOLK, VA.
Analytical and numerical investigation of structural response of compliant wall materials
[NASA-CR-156151] N78-21491

OPEN UNIV., MILTON (ENGLAND).
Combined heat and power: A discussion of Energy Paper 20
[ERG-018] N78-21608
Integrating wave power into the electricity supply system
[RR-20] N78-21609

OREGON GRADUATE CENTER FOR STUDY AND RESEARCH, PORTLAND.
A scanning ion microscope with a field ionization source
N78-21909
Structural and magnetic studies of selected rare earth intermetallics
N78-21949

OREGON UNIV., EUGENE.
Light scattering and Brownian motion
N78-21912

ORR-SCHELEN-MAYERON AND ASSOCIATES, INC., MINNEAPOLIS, MINN.
Grid-connected ICES preliminary feasibility analysis and evaluation. Volume 1: Executive summary
[COO/4214-1/1-VOL-1] N78-21641

OWENS-ILLINOIS, INC., TOLEDO, OHIO.
Development of prototype air/liquid solar collector subsystem
[NASA-CR-150627] N78-21604

OXFORD UNIV. [ENGLAND].
A new transient cascade facility for the measurement of heat transfer rates
N78-21149

P

PATENT AND TRADEMARK OFFICE, WASHINGTON, D. C.
Technology assessment and forecast report, 8 [PB-276375/3] N78-21989
PATRICK [ROBERT L.], NORTHRIDGE, CALIF.
Performances assurance and data integrity practices [PB-276400/9] N78-21819
PENNSYLVANIA STATE UNIV., STATE COLLEGE.
Scaling of cavitation damage [AD-A049766] N78-21419
PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
Empirical determination of vertical diffusion coefficients for Los Angeles [PB-275756/5] N78-21712
The development of a mesoscale semi-implicit numerical model N78-21716
Energy transfer at solid surfaces N78-21956
PENNSYLVANIA UNIV., PHILADELPHIA.
The unitarity constraint on the three-body final states N78-21896
PISA UNIV. [ITALY].
Calculation of temperature distribution in disks and cooling flow in a transient state N78-21157
PITTSBURGH UNIV., PA.
A fracture mechanics analysis of the kinetics of stress-corrosion crack growth in a high-strength 12Ni-5Cr-3Mo maraging steel N78-21256
Cooperative spontaneous emission and nonlinear stimulated emission N78-21439
Vacuum ultraviolet and visible radiation from electron impact excitation of nitrogen, hydrogen, oxygen, the light hydrocarbons and the rare gases N78-21897
POLITECNICO DI MILANO [ITALY].
High temperature corrosion of Ni-base for turbine blades alloys in sulphate-chloride containing environments N78-21140
Local flame temperature measurements by radiative methods N78-21153
POLYTECHNIC INST. OF NEW YORK, BROOKLYN.
Studies of parametric decay instabilities in magneto plasmas [AD-A049547] N78-21925
Improved calculations of X-ray and inelastic electron scattering Compton profiles [AD-A049513] N78-21960
POWER CONVERSION, INC., MOUNT VERNON, N. Y.
Manufacturing methods and technology for hermetically sealed lithium SO2 cell batteries [AD-A049943] N78-21617
POWER ELECTRONICS ASSOCIATES, INC., LINCOLN, MASS.
A 10kW lightweight dc converter: Technology feasibility study for lightweight megawatt range converters [AD-A049937] N78-21384
POWER PLANT SITING PROGRAM, ANNAPOLIS, MD.
Thermal discharges and their role in pending power plant regulatory decisions N78-21547
PRATT AND WHITNEY AIRCRAFT GROUP, EAST HARTFORD, CONN.
Mean velocity, turbulence intensity and turbulence convection velocity measurements for a convergent nozzle in a free jet wind tunnel [NASA-CR-2949] N78-21058
Evaluation of Federal Aviation Administration ion engine exhaust sampling rake [NASA-CR-135213] N78-21111
PRATT AND WHITNEY AIRCRAFT GROUP, WEST PALM BEACH, FLA.
Trends of future turbine life prediction: Time phase automated analysis and test verification N78-21143
Application of superplastic steels [AD-A049469] N78-21270
PRINCETON UNIV., N. J.
Optimal control theory [OWEM] applied to a helicopter in the hover and approach phase [NASA-CR-152135] N78-21161
Fundamental and semi-global kinetic mechanisms of hydrocarbon combustion [COO/4272-1] N78-21245
Propellant burning rate and combustion uniformity identified by ultrasonic acoustic emissions [AD-A049942] N78-21308
Oxidation kinetics of hydrocarbon fuels [AD-A050056] N78-21311
A three-dimensional study of fin-induced shock wave turbulent boundary layer interaction [AD-A049772] N78-21420
Further progress on robust/resistant widthers [AD-A049701] N78-21852
Drift waves in inhomogeneous plasmas with shear and temperature gradients N78-21919
Numerical simulations of collisionless drift instabilities for low-density plasmas [PPPL-1382] N78-21930
PURDUE RESEARCH FOUNDATION, LAFAYETTE, IND.
Flo-peeling and other alternatives to conventional turning [AD-A050123] N78-21475
PURDUE UNIV., LAFAYETTE, IND.
Studies of flash-induced photoelectrochemical processes N78-21229
Forest resource information system [E78-10114] N78-21519
A survey of computer architectures for image processing and pattern recognition [AD-A049536] N78-21784
A minimum principle for the smallest eigenvalue for second order linear elliptic equations with natural boundary conditions [AD-A050101] N78-21851

R

RADIAN CORP., AUSTIN, TEX.
Environmental assessment of low/medium BTU gasification [PB-276580/8] N78-21325
RADIO CORP. OF AMERICA, CAMDEN, N. J.
Studies for the development of a unified node employing dynamic channel location [AD-A049619] N78-21356
RADIO CORP. OF AMERICA, VAN NUYS, CALIF.
Bearing study program [AD-A049767] N78-21068
RAO AND ASSOCIATES, INC., PALO ALTO, CALIF.
Use of leaning vanes in a two stage fan [NASA-CR-152134] N78-21115
RAYTHEON CO., SUDBURY, MASS.
Future applications of low cost strapdown laser inertial navigation systems N78-21072
A review of methodologies and concepts to measure and evaluate aircraft survivability/vulnerability [AD-A050152] N78-21099
RAYTHEON CO., WALTHAM, MASS.
Surface acoustic wave stabilized oscillators [NASA-CR-156724] N78-21374
RAYTHEON CO., WAYLAND, MASS.
Unattended/minimally attended radar study. Volume 1: Summary [AD-A049776] N78-21346
Unattended/minimally attended radar study, volume 2 [AD-A049777] N78-21347
RCA SOLID STATE TECHNOLOGY CENTER, SOMERVILLE, N. J.
High-reliability, low-cost integrated circuits [AD-A049763] N78-21383
REGIONAL PLANNING COUNCIL, BALTIMORE, MD.
LANDSAT and other sensor data for land-use planning in the Baltimore area N78-21532
REMTECH, INC., HUNTSVILLE, ALA.
Pretest information for a test to validate plume simulation procedures [FA-17] [NASA-CR-150638] N78-21210
RENSSELAER POLYTECHNIC INST., TROY, N. Y.
Numerical investigation of the effect of a Coriolis force on the stability of plane Poiseuille flow [AD-A049521] N78-21414
RICE UNIV., HOUSTON, TEX.
Mathematics of operations research [AD-A049700] N78-21853
ROCHESTER UNIV., N. Y.
On the convolution of logistic random variables [AD-A049996] N78-21876
A study of the interaction of X-rays and acoustic waves in solids N78-21888
ROCKETDYNE, CANOGA PARK, CALIF.
Inorganic halogenoxidizer research [AD-A050133] N78-21238
ROCKWELL INTERNATIONAL CORP., ANAHEIM, CALIF.
Thin films of gallium arsenide on low-cost substrates [SAN/1202-77/2] N78-21965
ROCKWELL INTERNATIONAL CORP., CEDAR RAPIDS, IOWA.
A 4D approach control using VOR/DME/ILS guidance N78-21083
ROCKWELL INTERNATIONAL CORP., LOS ANGELES, CALIF.
Fiber Optics Cost Analysis Program [FOCAP] [AD-A049859] N78-21105
ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION, FORT COLLINS, COLO.
Inventory of forest resources [including water] by multi-level sampling [E78-10118] N78-21522
ROHDE AND SCHWARTZ, MUNICH [WEST GERMANY].
UHF DF triangulation system for control and guidance of military aircraft N78-21077
ROLLS-ROYCE LTD., BRISTOL [ENGLAND].
Project optimisation of military gas turbines with respect to turbine life N78-21120
ROSS [S.] AND CO., BOSTON, MASS.
Continued implementation and testing of a Neighborhood Office Center [NOC] and integration of the NOC with an administrative correspondence management information system [NASA-CR-156150] N78-21970

S

SACHS/FREEMAN ASSOCIATES, INC., HYATTSVILLE, MD.
IEMCAP implementation study, volume I [AD-A049739] N78-21344
IEMCAP implementation study. Volume 2: Annex electromagnetic compatibility handbook for system development and procurement [AD-A049738] N78-21357
SACRAMENTO PEAK OBSERVATORY, SUNSPOT, N. MEX.
Preliminary design analysis for the solar optical telescope main mirror actuator [NASA-CR-156701] N78-21999
SAINT LOUIS UNIV., MO.
Source parameters and the static field of earthquakes at near distances N78-21687
A numerical investigation of the boundary layer of an atmospheric mesoscale vortex N78-21688
LAPAC: A computer package for solving the Laplace transform N78-21837
SAN DIEGO GAS AND ELECTRIC CO., CALIF.
Geothermal environmental studies, Heber region, Imperial Valley, California. Environmental baseline data acquisition [EPRI-ER-352] N78-21630
SANDIA LABS., ALBUQUERQUE, N. MEX.
Accuracy limitation on strapdown calculations in a coning environment due to a given approximation to the body rate vector [SAND-77-0726] N78-21069
Sandia inertial terrain-aided navigation system [SAND-77-0521] N78-21070
Tunable diode laser heterodyne spectrometer for balloon-borne solar radiometry in the stratosphere [SAND-77-0601] N78-21463
High-pressure studies of soft mode transitions in solids [SAND-77-1188C] N78-21968
SANTA BARBARA RESEARCH CENTER, GOLETA, CALIF.
Continued development of doped-germanium photoconductors for astronomical observations at wavelengths from 30 to 120 micrometers [NASA-CR-152125] N78-22000
SCIENCE APPLICATIONS, INC., BERKELEY, CALIF.
Numerical results or multiconductor transmission line networks [AD-A049451] N78-21349
SCIENCE APPLICATIONS, INC., MCLEAN, VA.
Software engineering. Volume 1: Its development and standards [AD-A049869] N78-21813
SCIENTIFIC TRANSLATION SERVICE, SANTA BARBARA, CALIF.
Self-stabilization of a high pressure plasma in toroidal containers with an arbitrary shape for the magnetic axis [ERDA-TR-311] N78-21931
Induced oscillation instabilities and their role in Tokamaks with injected neutral particles [ERDA-TR-312] N78-21932
Bounce effects in the instability theory of trapped alpha particles in the Tokamak reactor [ERDA-TR-313] N78-21933
Tokamak impurity instabilities [ERDA-TR-314] N78-21934
SHARED APPLICATIONS, INC., ANN ARBOR, MICH.
Analysis of distributed-emission crossed-field amplifiers [AD-A050185] N78-21391

SIEMENS A.G., MUNICH [WEST GERMANY].
An ECM-resistant communication and ranging system for remotely piloted vehicles
N78-21080

SINGER CO., LITTLE FALLS, N. J.
New techniques for low cost strapdown inertial systems
N78-21073

SMITHSONIAN INSTITUTION, EDGEWATER, MD.
Relationship of land use to water quality in the Chesapeake Bay region
N78-21544

SOCIETE NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION, VILLAROCHE [FRANCE].
Adapting a turbine engine test stand for high temperature research
N78-21124

SOCIETE NATIONALE INDUSTRIELLE AEROSPATIALE, TOULOUSE [FRANCE].
Inertial smoothing and extrapolation of ILS beams: Application to the Airbus A 300 B
N78-21074

SOFTECH, INC., WALTHAM, MASS.
Communications high-order language investigation, volume 1
[AD-A049737] N78-21340
Communications high-order language investigation, volume 2
[AD-A049736] N78-21341

SOLAR ENGINEERING AND MFG. CO., DEERFIELD BEACH, FLA.
Preliminary design package for solar hot water system
[NASA-CR-150617] N78-21603

SOLAR TURBINES INTERNATIONAL, SAN DIEGO, CALIF.
Development of a ceramic tube heat exchanger with relaxing joint
[FE-2556-06] N78-21423
Test evaluation of stationary and rotating diffusers for a high pressure ratio radial compressor
[AD-A049856] N78-21474

SOUTH AFRICAN BUREAU OF STANDARDS, PRETORIA.
Tables of Brinell and Vickers hardness values for metallic materials with flat surfaces, and of correction factors [Vickers] for curved surfaces
[SABS-055A-1977] N78-21262
Code of practice for the cupping test for sheet and strip metal [modified Erichsen test]
[SABS-0138-1977] N78-21263
Code of practice for methods for hardness testing of metallic materials
[SABS-055-1977-REV-1] N78-21264
Code of practice for welding. Part 5: Welders' competence tests for manual oxy-acetylene, manual metal-arc, manual gas-shielded tungsten-arc, and manual gas-shielded metal-arc welding of mild steel [carbon steel] and medium high tensile steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-5-1976-REV-1] N78-21467
Code of practice for welding. Part 7: Welders' competence tests for manual metal-arc, manual inert gas-shielded tungsten-arc, and manual inert gas-shielded metal-arc welding of austenitic stainless and austenitic heat resisting steel pipelines and pipe assemblies
[SABS-044-PT/DEEL-7-1976] N78-21468

SOUTH CAROLINA UNIV., COLUMBIA.
Convergence of weighted sums of random elements and statistical applications
N78-21872

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, RAPID CITY.
An investigation of the influence of shock-wave profile on the mechanical and thermal responses of polycrystalline iron
[AD-A049764] N78-21278

SOUTH DAKOTA STATE UNIV., BROOKINGS.
HCMM energy budget data as a model input for assessing regions of high potential groundwater pollution
[E78-10111] N78-21516

SOUTHAMPTON UNIV. [ENGLAND].
Review of diesel combustion models for NOx and smoke emissions
[PB-276350/6] N78-21681

SOUTHERN RESEARCH INST., BIRMINGHAM, ALA.
Inertial cascade impactor substrate media for flue gas sampling
[PB-276583/2] N78-21668

SOUTHWEST RESEARCH INST., SAN ANTONIO, TEX.
Study of environmental effects on thermomechanical behavior of resin-base composites
[AD-A049538] N78-21225
Nondestructive evaluation of metal fatigue
[AD-A049539] N78-21277

SPACE AND MISSILE SYSTEMS ORGANIZATION, EL SEGUNDO, CALIF.
Applications of the NAVSTAR global positioning system to military guidance and control
N78-21085

SRI INTERNATIONAL CORP., MENLO PARK, CALIF.
Study of metastable rare gas collisions with halogens
[AD-A049829] N78-21449
Interactive aids for cartography and photo interpretation
[AD-A049768] N78-21578
Fuel and energy price forecasts: Quantities and long-term marginal prices, volume 1
[EPRI-EA-433-VOL-1] N78-21637
The relation of oxidant levels to precursor emissions and meteorological features. Volume 2: Review of available research results and monitoring data, as of November 1975
[PB-275326/7] N78-21672
The relation of oxidant levels to precursor emissions and meteorological features. Volume 3: Appendices [analytical methods and supplementary data]
[PB-275327/5] N78-21673
Inelastic collisions of excited atoms
[AD-A050037] N78-21901

STANDARD ELECTRIK LORENZ A.G., STUTTGART [WEST GERMANY].
Precise enroute navigation based on ground-derived techniques
N78-21078
One-way ranging with TACAN
N78-21079

STANFORD RESEARCH INST., MENLO PARK, CALIF.
Earthquake prediction uncertainty, and policies for the future: A technology assessment of earthquake prediction
[PB-275581/7] N78-21713

STANFORD UNIV., CALIF.
A study of the Peninsula Method for the controlled artificial generation of ULF waves in the ionosphere and magnetosphere
[AD-A049514] N78-21354
Free electron laser theory
N78-21437
Optically pumped mercury laser for absolute frequency stabilization
N78-21440
Generation of coherent VUV and soft X-rays
[AD-A049858] N78-21450
Optically pumped mercury lasers for ring laser gyroscope applications
[AD-A049540] N78-21455
Energy storage and two-photon extraction from metastable states
[AD-A050075] N78-21459
Evaluation of lithium titanates as cathode materials
N78-21588
Earthflow
N78-21684
Motivation and intensionality in a computer simulation model
N78-21790
A hybrid approach to multi-stage linear programs
[AD-A049477] N78-21798
A further investigation of efficient heuristic procedures for integer linear programming with an interior
[AD-A049593] N78-21804
At the interface of modeling and algorithms research
[AD-A049757] N78-21806
Synthesis: Dreams yield programs
[AD-A049761] N78-21814
Optimal dispatching of a finite capacity shuttle
[AD-A049595] N78-21824
Extremal problems in quasiconformal mappings with side conditions
N78-21831
Distribution of a sum of weighted chi-square variables
[AD-A049986] N78-21855
Approximate solutions for certain optimal stopping problems
[AD-A049995] N78-21856
Confidence intervals related to sequential tests for the exponential distribution
[AD-A049758] N78-21863
A non-linear renewal theory with applications to sequential analysis, 2
[AD-A049783] N78-21864
The convergence of functions to fixed points of recursive definitions
[AD-A049760] N78-21866
A study of renewal processes with IMRL and DFR interarrival times
[AD-A049989] N78-21875
Some numerical results on asymptotic failure distributions
[AD-A049775] N78-21879
Estimation following sequential tests
[AD-A049784] N78-21880
Response functions in a one-dimensional Fermi gas and renormalization-group treatment of one-dimensional kondo lattices
N78-21938
Photoemission studies of layered transition metal dichalcogenides
N78-21948
Static and dynamic textures in superfluid He-3
N78-21954
Properties of new superconducting materials
[AD-A050296] N78-21959
Development and application of data processing and pattern recognition methods
[AD-A049846] N78-21982
Shielding by a surface layer of electrons, 1. Weak electromagnetic fields near a black hole, 2.
N78-22003

STATE UNIV. OF NEW YORK, ALBANY.
Energy conservation via solar energy application to multi-family and commercial structures. Volume 2, part 2: Solar energy atlas for New York state
[PB-276130/2] N78-21618
Energy conservation via solar energy applications to multi-family and commercial structures. Volume 3: An energy, engineering and economic analysis of heating and cooling systems for multi-family structures
[PB-276131/0] N78-21657

STATE UNIV. OF NEW YORK, BUFFALO.
Contributions to the dimensional theory
N78-21835

STATE UNIV. OF NEW YORK, STONY BROOK.
Variation of interdiffusion coefficient and ratio of intrinsic diffusion coefficients with composition in the NiAl [delta] phase of the Al-Ni system
N78-21257
Planner's energy workbook: A manual for exploring relationships between land use and energy utilization
[BNL-50633] N78-21634
Critical phenomena of inhomogeneous ising models
N78-21939
Intrinsic fluctuation of thin film microbridges
N78-21947

STATE UNIV. OF NEW YORK, SYRACUSE.
Coastal wetlands along Lake Ontario and the St. Lawrence in Jefferson County, New York
[PB-276031/2] N78-21744

SUSSEX UNIV., BRIGHTON [ENGLAND].
Performance and design of transportation-cooled turbine blading
N78-21129
Heat transfer from turbine and compressor discs
N78-21133
The effect of free-stream turbulence upon heat transfer to turbine blading
N78-21155
Flow and heat transfer in rotating coolant channels
N78-21156

SYRACUSE UNIV., N. Y.
Experimental validation of the Antenna Pattern Distortion Computer Program, VHF antenna
[AD-A049740] N78-21345
Matrix inversion using the RADC STARAN associative array processor
[AD-A049617] N78-21849

SYSTEMS AND APPLIED SCIENCES CORP., RIVERDALE, MD.
Software development: Stratosphere modeling
[NASA-CR-156722] N78-21692
Analysis of global oceanic rainfall from microwave data
[NASA-CR-156737] N78-21719

SYSTEMS CONTROL, INC., WEST PALM BEACH, FLA.
Area navigation systems and procedures
N78-21091

SYSTEMS RESEARCH LABS., INC., DAYTON, OHIO.
AFAL tower characterization facility: 4 km weather instrumentation tower
[AD-A049525] N78-21067

SYSTEMS SCIENCE AND SOFTWARE, LA JOLLA, CALIF.
Seismic studies of surface and body waves for improved yield determination
[AD-A049958] N78-21705

T

TECHNISCHE HOCHSCHULE, AACHEN [WEST GERMANY].
Investigations of the local heat transfer coefficient of a convection cooled rotor blade
N78-21126

TECHNISCHE HOCHSCHULE, DARMSTADT [WEST GERMANY].
The influence of coolant turbulence intensity of film cooling effectiveness
N78-21136

TECHNISCHE HOGESCHOOL, DELFT [NETHERLANDS].
The calculation of RMS values of deviations of aircraft controlled to fly along a desired flight path
N78-21084
Heat transfer characteristics of the closed thermosyphon system
N78-21132

TECHNOLOGY, INC., HOUSTON, TEX.
Microprocessor-based cardiopulmonary monitoring system
[NASA-CR-151688] N78-21752
TELEDYNE CAE, TOLEDO, OHIO.
The status of small, cooled, axial-flow turbines
N78-21123
TENNESSEE TECHNOLOGICAL UNIV., COOKEVILLE.
The torsional analysis of steady state and transient wave propagation in elastic cylinders
N78-21487
TENNESSEE UNIV., KNOXVILLE.
Energy conservation in the home: An energy education/conservation curriculum guide for home economics teachers
[EDM-1028] N78-21607
Estimation of the operating characteristics of item response categories. 1: Introduction to the two-parameter beta method
[AD-A049618] N78-21873
Structure of multiply ionized heavy ions and associated collision phenomena
[AD-A049762] N78-21902
TENNESSEE UNIV. SPACE INST., TULLAHOMA.
Summer faculty systems design program. Integrating wind tunnels and computers. Volume 2: Details of summer design study USAF/OSR/ASEE
[AD-A050071] N78-21167
Summer faculty systems design program. Integrating wind tunnels and computers. Volume 1: Executive summary. USAF/OSR/ASEE
[AD-A050072] N78-21171
TENNESSEE VALLEY AUTHORITY, MUSCLE SHOALS, ALA.
Technical assessment of NOx removal processes for utility application
[PB-276637/6] N78-21670
TEXAS A&M UNIV., COLLEGE STATION.
Analysis of synthetic aperture radar imagery
[NASA-CR-156743] N78-21339
Systems of generalized Abel integral equations with applications to simultaneous dual relations
[AD-A049446] N78-21844
Systems of generalized Abel integral equations
[AD-A050001] N78-21857
TEXAS CHRISTIAN UNIV., FORT WORTH.
Experimental determination of nonlinear constants for self-focusing and stimulated Raman emission
N78-21438
TEXAS UNIV., AUSTIN.
A road map of methods for approximating solutions of two-point boundary-values problems
[AD-A049971] N78-21858
TORONTO UNIV. [ONTARIO].
Effects of impurities on shock wave stability and structure in ionizing monatomic gases
[UTIAS-TN-212] N78-21405
Design method for heat loss calculation for in-ground heat storage tanks
[COO-2923-3] N78-21625
Solar space heating systems using annual heat storage
[COO/2939-1] N78-21645
TRANSPORT AND ROAD RESEARCH LAB., CROWTHORNE [ENGLAND].
The use of satellite imagery for highway engineering in overseas countries
[PB-276669/9] N78-21328
Evaluation of noise nuisance: A study of willingness to receive payment for noise introduced into the home
[PB-276418/1] N78-21658
TRW DEFENSE AND SPACE SYSTEMS GROUP, REDONDO BEACH, CALIF.
Stored charge release in cables in low fluence X-ray environments
[AD-A050112] N78-21376
Improvements to SEMANOL, volume 1
[AD-A049472] N78-21793
SEMANOL [76] reference manual, volume 2
[AD-A049473] N78-21794
SEMANOL [76] specification of Jovial [J3], volume 3
[AD-A049474] N78-21795
SEMANOL [76] interpreter documentation, volume 4
[AD-A049475] N78-21796
TURBOMECA S. A. - BREVETS SZYDLOWSKI, BIZANOS [FRANCE].
Problems concerning high temperatures in small turbomachines
N78-21121

U

UNITED STATES SENATE, WASHINGTON, D. C.
The Chesapeake Bay: Our regional resource
N78-21527
UNITED TECHNOLOGIES RESEARCH CENTER, EAST HARTFORD, CONN.
Study of the effects of gaseous environments on sulfidation attack of superalloys
[NASA-CR-135348] N78-21268
Development of SiAlON materials
[NASA-CR-135290] N78-21289
UNIVERSITY OF SOUTHERN CALIF., LOS ANGELES.
Photochemical and kinetic studies of some metal dithizonate complexes
[AD-A049872] N78-21243
Thermochemistry and kinetics of sulfur containing molecules and radicals
[PB-275721/9] N78-21247
The vaporization behavior of a fuel drop on a hot surface
[AD-A049471] N78-21303
Direct transformation of variational problems into Cauchy systems. 1: Scalar-quadratic case
[AD-A049526] N78-21847
Direct transformation of variational problems into cauchy systems. 2: Scalar-semi-quadratic case
[AD-A049527] N78-21848
UTAH STATE UNIV., LOGAN.
Analysis of EUV solar line profiles of Si-2 and Si-3
N78-22009
UTAH UNIV., SALT LAKE CITY.
Microstructure evolution during sintering of beta - alumina compositions
N78-21258

V

VARIAN ASSOCIATES, PALO ALTO, CALIF.
Klystron-twt hybrid efficiency improvement
[AD-A050125] N78-21377
VERMONT UNIV., BURLINGTON.
Radiographic and biomechanical studies of the human spine
[AD-A049984] N78-21758
VIRGINIA INST. OF MARINE SCIENCE, GLOUCESTER POINT.
Progress toward a circulation atlas for application to coastal water siting problems
[VIMS-CONTRIB-823] N78-21560
VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG.
A depolarization and attenuation experiment using the COMSTAR and CTS satellites
[NASA-CR-156730] N78-21336
Analysis of data and results for the roundrobin flat-plate collector test program
[PB-275576/7] N78-21655
Air pollution modeling
N78-21663
Nonparametric procedures for process control
N78-21870
Quasiclassical methods in the linear Heisenberg model
N78-21940
VIRGINIA UNIV., CHARLOTTESVILLE.
Enhancement of heat transfer by flow pulsations
N78-21398
Dynamic response of linear damped continuous structural members
N78-21485
VON KARMAN INST. FOR FLUID DYNAMICS, RHODE-SAINT-GENESE [BELGIUM].
The measurement of film cooling effectiveness on turbine components in short duration wind tunnels
N78-21152
VOUGHT CORP., HAMPTON, VA.
Low-speed aerodynamic characteristics from wind-tunnel tests of a large-scale advanced arrow-wing supersonic-cruise transport concept
[NASA-CR-145280] N78-21053
VOUGHT CORP., MOUNTAIN VIEW, CALIF.
Space shuttle L-tube radiator testing
[NASA-CR-151695] N78-21196

W

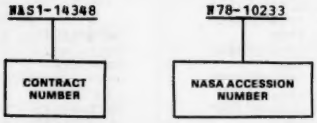
WALES UNIV. INST. OF SCIENCE AND TECHNOLOGY, CARDIFF.
Heat transfer to a PVD rotor blade at high subsonic passage throat Mach numbers
N78-21150
WASHINGTON CENTER FOR METROPOLITAN STUDIES, WASHINGTON, D. C.
Colder - darker: The energy crisis and low-income Americans; an analysis of impact and options
[PB-275656/7] N78-21656
WASHINGTON STATE UNIV., PULLMAN.
Gravity segregation of primary particles during solidification of binary eutectiferous alloys
N78-21261
WASHINGTON UNIV., SEATTLE.
A perturbation method for predicting amplitudes of nonlinear wheel shimmy
N78-21464
Dynamic photoelastic and dynamic finite element analyses of dynamic tear test specimens
[AD-A049780] N78-21504
Identification and tracing of water masses with an application near the Galapagos Islands
N78-21736
Coastal upwelling ecosystems analysis, data report 39. Joint 2: R/V Thomas G. Thompson cruise 108 leg 1, CTD measurements off the coast of Peru near Cabo Nazca, April - May 1976
[PB-276532/9] N78-21742
Coastal upwelling ecosystems analysis, data report 40. Joint 2: R/V Thomas G. Thompson cruise 108 legs 2 and 3, CTD measurements off the coast of Peru near Cabo Nazca, May - June 1976
[PB-276533/7] N78-21743
Use of Floyd's algorithm to find shortest restricted paths
[AD-A049467] N78-21797
An alternative method for a global analysis of quadratic programs in a finite number of steps
[AD-A049756] N78-21805
A new approach to computer aided transient analysis of stiff linear networks
N78-21818
WATERLOO UNIV. [ONTARIO].
Studies on methods of reducing heat losses from flat plate solar collectors, phase 2
[COO/2597-3] N78-21624
WEBB INST. OF NAVAL ARCHITECTURE, GLEN COVE, N.Y.
Wave measurement and implementation aboard ship
[PB-276070/0] N78-21741
WEIZMANN INST. OF SCIENCE, REHOVOTH [ISRAEL].
The convergence of functions to fixed points of recursive definitions
[AD-A049760] N78-21866
WESTINGHOUSE ELECTRIC CORP., LESTER, PA.
High Temperature Turbine Technology Program. Phase 1: Program and system definition. Topical report: Low BTU gas combustor technology development plan
[FE-2290-26] N78-21480
WESTINGHOUSE ELECTRIC CORP., MADISON, PA.
Basic creep-rupture testing at 1100 deg F [593 deg C] of type 304 stainless steel for uniaxially loaded specimens with stress and strain gradients
[WARD-HT-3045-26] N78-21284
WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA.
Metastable metallic superconductors with high transition temperatures and composite superconductors
[AD-A050055] N78-21282
Controlled impedance short circuit limiter
[EPRI-EL-537] N78-21392
WICHITA STATE UNIV., KANS.
Fatigue in adhesively bonded laminates
[AD-A049529] N78-21271
WILLIAMSON ENGINEERING ASSOCIATES, INC., NAVARRE, FLA.
The application of wind energy systems to desalination
[PB-276174/0] N78-21620
WISCONSIN UNIV., MADISON.
Time- and space-resolved species determination in diesel combustion using continuous flow gas sampling
N78-21227
Multivariable computer control of a gas metal arc welding process
N78-21466
The Landau problem for motions on curves
[AD-A049492] N78-21828
On a measure of lack of fit in time series models
[AD-A049397] N78-21860
Application and numerical solution of Abel-type integral equations
[AD-A049396] N78-21861
Asymptotic distribution of symmetric statistics
[AD-A049395] N78-21862
Theory and simulation of the stability of Bernstein-Greene-Kruskal waves
N78-21918
WRIGHT STATE UNIV., DAYTON, OHIO.
Multi-item scheduling in reparable item inventory systems with reflection programming
[AD-A049553] N78-21808
Algorithms for computing repair schedules in probabilistic environments
[AD-A049554] N78-21809
WYOMING UNIV., LARAMIE.
Boolean algebras with partitioning bases
N78-21836
The comprehension factor in randomized response
N78-21869

Y

YALE UNIV., NEW HAVEN, CONN.
The stability of second order quadratic differential equations
[AD-A049771] N78-21865
YESHIVA UNIV., NEW YORK.
Decomposition theorems for differential forms on Hilbert spaces
N78-21885
Electroreflectance in semiconductors and its application as a method of materials characterization
N78-21950

CONTRACT NUMBER INDEX

Typical Contract Number Index Listing



Listings in this index are arranged alphanumerically by contract number. Under each contract number the NASA accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order. The NASA accession number denotes the number by which the citation is identified.

AF MIPR-FQ8952-76-66005
N78-21170
AF PROJ. 6498
N78-21335
AF PROJ. 2301
N78-21342
N78-21343
N78-21359
AF PROJ. 2304
N78-21808
N78-21809
N78-21876
AF PROJ. 2305
N78-21455
AF PROJ. 2306
N78-21959
AF PROJ. 2307
N78-21225
N78-21277
AF PROJ. 2308
N78-21302
N78-21307
AF PROJ. 2312
N78-21758
AF PROJ. 2418
N78-21272
AF PROJ. 6244
N78-21825
AF PROJ. 6690
N78-21700
AF PROJ. 7351
N78-21272
AF PROJ. 9782
N78-21225
N78-21277
AF-AFOSR-73-2435-73
N78-21959
AF-AFOSR-74-2668
N78-21925
AF-AFOSR-75-2773
N78-21276
AF-AFOSR-2363D-72
N78-21860
AF-AFOSR-2604-74
N78-21311
AF-AFOSR-2605-76
N78-21971
AF-AFOSR-2685-74
N78-21236
AF-AFOSR-2730-74
N78-21367
AF-AFOSR-2738-74
N78-21758
AF-AFOSR-2793-75
N78-21821
N78-21822
N78-21882
N78-21883
N78-21884
AF-AFOSR-2794-75
N78-21241
AF-AFOSR-2805-75
N78-21304
AF-AFOSR-2818-75
N78-21414
AF-AFOSR-2876-76
N78-21303
AF-AFOSR-2919-76
N78-21281
AF-AFOSR-2923-76
N78-21830
AF-AFOSR-2994-76
N78-21271
AF-AFOSR-3009-76
N78-21365
N78-21366
AF-AFOSR-3011-76
N78-21808
N78-21809
AF-AFOSR-3025-76
N78-21359
AF-AFOSR-3043-76
N78-21455
AF-AFOSR-3046-76
N78-21846
AF-AFOSR-3058-76
N78-21224
AF-AFOSR-3065-76
N78-21360
AF-AFOSR-3115-77
N78-21302
AF-AFOSR-3148-77
N78-21973
AF-AFOSR-3157-76
N78-21503
AF-AFOSR-3158-77
N78-21162
AF-AFOSR-3177-77
N78-21829
AF-AFOSR-3271-77
N78-21820
N78-21826
N78-21845
AF-AFOSR-3286-77
N78-21851
AF-AFOSR-3289-77
N78-21167
N78-21171
AF-AFOSR-3290-77
N78-21844
N78-21857
AF-AFOSR-3303-77
N78-21405
AF-AFOSR-3360-77
N78-21876
AF-AFOSR-3367-77
N78-21786
AF-AFOSR-3375-77
N78-21361
AF-AFOSR-3383-77
N78-21847
N78-21848
APL/JHU-600276
N78-21401
N78-21402
ARPA ORDER 600
N78-21391
ARPA ORDER 1733
N78-21354
ARPA ORDER 1806
N78-21448
N78-21456
ARPA ORDER 2466
N78-21785
ARPA ORDER 2494
N78-21814
N78-21866
ARPA ORDER 2782
N78-21450
ARPA ORDER 2894
N78-21578
ARPA ORDER 2928
N78-21975
ARPA ORDER 3175
N78-21195
ARPA ORDER 3206
N78-21799
N78-21800
N78-21801
N78-21802
N78-21823
ARPA ORDER 3345
N78-21576
ARPA ORDER 3414
N78-21810
ARPA ORDER 3441
N78-21961
CSA-B6B-5522 N78-21656
CSA-20156 N78-21654
DA PROJ. 1F2-62209-AH-76
N78-21098
DA PROJ. 1L7-62701-AH-92
N78-21773
N78-21774
N78-21775
N78-21779
N78-21782
DA PROJ. 1T1-61101-A-91A
N78-21914
DA PROJ. 1T1-61102-B-00B
N78-21236
DA PROJ. 1T1-61102-BH-57
N78-21274
DA PROJ. 1T1-62105-AH-84
N78-21279
DA PROJ. 1T6-65702-D-127
N78-21726
N78-21727
N78-21728
DA PROJ. 3E7-62772-A-813
N78-21462
DA PROJ. 4A1-61102-B-52C
N78-21577
DA PROJ. 4A7-62725-AT-11
N78-21813
DA PROJ. 4A7-62731-AT-41
N78-21615
DA PROJ. 1L1-61102-AH-45
N78-21410
DA-ERO-75-G-074
N78-21152
DA-ERO-76-G-068
N78-21297
DAAA21-74-C-0332
N78-21308
DAAB07-74-C-0341
N78-21236
DAAB07-76-C-0042
N78-21617
DAAC29-74-C-0034
N78-21804
DAAF03-73-C-0012
N78-21475
DAAG29-74-C-0034
N78-21798
DAAG29-75-C-0024
N78-21828
N78-21860
N78-21861
N78-21862
DAAG29-75-G-0187
N78-21389
DAAG29-76-C-0057
N78-21578
DAAG29-76-G-0038
N78-21877
DAAG29-76-G-0039
N78-21274
DAAG29-76-G-0067
N78-21350
N78-21351
DAAG29-76-G-0181
N78-21278
DAAG29-76-G-0269
N78-21420
DAAG29-76-G-0294
N78-21859
DAAG29-76-G-0298
N78-21852
DAAG29-77-G-0015
N78-21236
DAAG29-77-G-0031
N78-21855
N78-21856
N78-21875
N78-21878
DAAG46-76-C-0046
N78-21279
DAAG53-76-C-01
N78-21801
DAAG53-76-C-0107
N78-21474
DAAG53-76-C-0138
N78-21799
N78-21800
N78-21802
N78-21803
N78-21823
DAAG53-76-C-0146
N78-21379
DAAG53-76-C-0195
N78-21913
DAAJ01-71-C-0840
N78-21163
N78-21164
DAAJ02-75-C-0017
N78-21098
DACA88-76-C-0010
N78-21813
DADA17-72-C-2177
N78-21462
DAHC04-74-C-0028
N78-21476
DAHC04-74-G-0160
N78-21432
DAHC04-74-G-0223
N78-21853
DAHC04-75-G-0122
N78-21905
DAHC04-75-G-0150
N78-21971
DAHC04-75-G-0187
N78-21389
DAHC04-76-G-0012
N78-21853
DAHC04-76-G-0305
N78-21853
DAHC15-73-C-0200
N78-21168
DARPA ORDER 3206
N78-21803
DCA100-76-C-0047
N78-21353
DI-BM-JQ-188017
N78-21585
DI-14-16-008-2018
N78-21524
DI-14-16-0008-2156
N78-21579
DI-14-34-0001-7523
N78-21620
DNA MIPR 77-522
N78-21702
DNA001-77-C-0084
N78-21376
DOT-CG-61505-A
N78-21666
DOT-CG-74132-A
N78-21309
DOT-FA6WA-3855
N78-21065
DOT-FA75WA-3658
N78-21097
DOT-FA76WAI-610
N78-21234

DOT-FA76WAI-612 N78-21335
DOT-FA77WAI-708 N78-21111
DOT-FH-11-7730 N78-21676
DOT-TSC-939 N78-21893
DOT-TSC-1101 N78-21681
DRNE-76/534 N78-21749
EC-77-A-31-1040 N78-21472
EC-77-C-02-4210 N78-21638
EC-77-C-02-4212 N78-21639
EC-77-C-02-4214 N78-21641
EC-77-S-02-4272 N78-21245
EF-77-C-01-2352 N78-21632
EF-77-C-01-2556 N78-21423
EPA-68-01-3188 N78-21661
EPA-68-02-1438 N78-21667
EPA-68-02-1869 N78-21682
EPA-68-02-2084 N78-21672 N78-21673
EPA-68-02-2125 N78-21680
EPA-68-02-2131 N78-21668
EPA-68-02-2147 N78-21325
EPA-68-02-2160 N78-21677 N78-21678
EPA-68-02-2273 N78-21248
EPA-68-03-2071 N78-21992 N78-21993
EPRI PROJ. 493 N78-21477
EPRI PROJ. 598 N78-21478
EPRI PROJ. 654 N78-21392
EPRI PROJ. 759-1 N78-21637
ES-77-A-01-6021 N78-21923
EX-76-C-01-1534 N78-21320
EX-76-C-01-2203 N78-21319
EX-76-C-01-2290 N78-21480
EX-76-C-01-2460 N78-21646
EY-76-C-02-0003 N78-21316 N78-21317
EY-76-C-02-0016 N78-21633 N78-21634
EY-76-C-02-2597 N78-21624
EY-76-C-02-2619 N78-21651
EY-76-C-02-2749 N78-21479
EY-76-C-02-2939 N78-21625 N78-21645
EY-76-C-02-2991 N78-21321
EY-76-C-02-3045-006 N78-21284
EY-76-C-02-3073 N78-21930
EY-76-C-03-1178 N78-21640
EY-76-C-04 0613 N78-21435
EY-76-C-04-0487 N78-21434
EY-76-C-04-0789 N78-21069 N78-21070 N78-21463 N78-21968
EY-76-C-05-0033 N78-21643 N78-21652 N78-21653
EY-76-C-06-1830 N78-21649 N78-21671
EY-76-C-07-1570 N78-21642
EY-76-S-02-2486 N78-21760
EY-76-S-02-2641 N78-21424
EY-76-S-03-0326 N78-21798 N78-21806
EY-76-S-03-1202 N78-21965
EY-76-S-05-5049 N78-21607
EY-76-S-09-0893 N78-21626 N78-21627 N78-21628 N78-21629
EY-76-S-03-0326 N78-21805
F-INK-07-11966/02871 N78-21062
F-INK-07-21898 N78-21062
F-INK-11-12-02871 N78-21062
F-INK-11-12-83343 N78-21062
F-INK-82223-76-001-21-001 N78-21062
FEA-CA-05-50041-00 N78-21580
F04611-76-0057 N78-21355
F04701-77-C-0078 N78-21242 N78-21811
F08606-76-C-0041 N78-21705
F09603-77-A-3104 N78-21066
F19628-76-C-0002 N78-21391 N78-21576
F19628-76-C-0240 N78-22013
F19628-76-C-0286 N78-21706
F19628-78-C-002 N78-22001
F19628-78-C-0002 N78-21186
F19628-78-C-0006 N78-21335
F29601-76-C-0125 N78-21349
F30602-75-C-0109 N78-21356
F30602-75-C-0121 N78-21345 N78-21849
F30602-76-C-0130 N78-21377
F30602-76-C-0134 N78-21385
F30602-76-C-0238 N78-21793 N78-21794 N78-21795 N78-21796
F30602-76-C-0296 N78-21825
F30602-76-C-0306 N78-21340 N78-21341
F30602-76-C-0356 N78-21344 N78-21357
F30602-76-C-0389 N78-21346 N78-21347
F30602-76-C-0439 N78-21378
F33615-73-C-0678 N78-21099
F33615-75-C-3105 N78-21101
F33615-76-C-1092 N78-21067
F33615-76-C-1260 N78-21105
F33615-76-C-2050 N78-21384
F33615-76-C-5227 N78-21272
F33615-77-C-5114 N78-21270
F33625-76-C-2018 N78-21146
F44620-C-0033 N78-21930
F44620-73-C-0022 N78-21460
F44620-73-C-0074 N78-21783 N78-21785
F44620-74-C-0039 N78-21459
F44620-74-C-0042 N78-21282
F44620-74-C-0054 N78-21352
F44620-74-C-0079 N78-21804
F44620-75-C-0009 N78-21699
F44620-75-C-0016 N78-21415
F44620-75-C-0041 N78-21461
F44620-75-C-0042 N78-21277
F44620-75-C-0059 N78-21305
F44620-76-C-0009 N78-21756 N78-21764 N78-21765 N78-21771
F44620-76-C-0016 N78-21307
F44620-76-C-0054 N78-21342 N78-21343
F44620-76-C-0058 N78-21213
F44620-76-C-0062 N78-21432
F44620-76-C-0067 N78-21447
F44620-76-C-0093 N78-21225
F49620-76-C-0001 N78-21755
F49620-77-C-0030 N78-21418
HA-2-4216 N78-21741
HDA903-76-C-0206 N78-21814 N78-21866
NASA ORDER A-29674B N78-21590
NASA ORDER S-40255B N78-21518
NASA ORDER S-54049A N78-21524
NASA ORDER S-54053A N78-21522
NASA ORDER S-54177A N78-21999
NASW-2790 N78-21172 N78-21212 N78-21411 N78-21412
N78-21751 N78-21900
NASW-2791 N78-21048 N78-21176 N78-21192 N78-21231 N78-21232 N78-21575 N78-21904 N78-21957
NASW-2856 N78-21181
NASW-3047 N78-21573
NASW-3057 N78-21970
NAS1-13500 N78-21053
NAS1-13624 N78-21093
NAS1-13931 N78-21219
NAS1-14101 N78-21840
NAS1-14402 N78-21047
NAS1-14404 N78-21890
NAS2-7187 N78-21161
NAS2-7862 N78-21235
NAS2-8143 N78-21445
NAS2-8612 N78-21095
NAS2-8680 N78-21115
NAS2-8699 N78-21223
NAS2-9599 N78-22000
NAS3-16732 N78-21147
NAS3-17866 N78-21058
NAS3-19427 N78-21472
NAS3-19447 N78-21111
NAS3-19697 N78-21493 N78-21494
NAS3-19712 N78-21289
NAS3-19777 N78-21044
NAS3-20039 N78-21268
NAS3-20051 N78-21471
NAS3-20098 N78-21265
NAS5-20812 N78-21720
NAS5-21808 N78-21511 N78-21512
NAS5-22375 N78-22016
NAS5-22577 N78-21336
NAS5-22859 N78-21427
NAS5-22955 N78-21442 N78-21443
NAS5-22983 N78-22007
NAS5-23458 N78-21339
NAS5-23693 N78-21606
NAS5-23701 N78-21374
NAS5-23751 N78-21572
NAS5-23850 N78-21337
NAS5-23852 N78-21719
NAS5-23854 N78-21694
NAS5-24112 N78-21525
NAS5-24206 N78-21516
NAS5-24255 N78-21692
NAS6-2456 N78-21428 N78-21429
NAS7-100 N78-21057 N78-21173 N78-21333 N78-21523 N78-21569 N78-21598 N78-21599 N78-21600 N78-21601 N78-21664
NAS8-31333 N78-21717
NAS8-31947 N78-21665
NAS8-32036 N78-21589 N78-21593 N78-21594 N78-21595
NAS8-32128 N78-21210
NAS8-32245 N78-21591
NAS8-32248 N78-21603
NAS8-32255 N78-21592
NAS8-32259 N78-21604
NAS8-32261 N78-21602
NAS8-32702 N78-21175
NAS9-10534 N78-21196
NAS9-13669 N78-21767
NAS9-14318 N78-21792
NAS9-14533 N78-21515
NAS9-14880 N78-21752
NAS9-14899 N78-21517
NAS9-15000 N78-21841 N78-21842

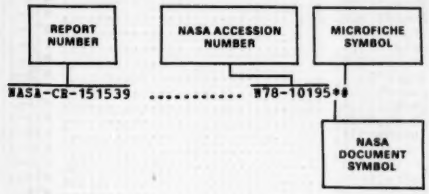
NAS9-15200 N78-21338
N78-21574
NAS9-15302 N78-21301
NAS9-15325 N78-21519
NAS9-15335 N78-21197
NAS9-15378 N78-21753
NBS-G7-9001 N78-21244
NGL-05-003-404
N78-21520
NGL-22-009-124
N78-21838
NGL-47-003-039
N78-21096
NGL-47-022-005
N78-21560
NGR-22-009-378
N78-21116
NGR-33-009-181
N78-21236
NOAA-6-35358 N78-21731
NR PROJ. 036-085,
N78-21273
NR PROJ. 042-002
N78-21879
NR PROJ. 042-331
N78-21856
NR PROJ. 042-373
N78-21863
N78-21864
N78-21880
NR PROJ. 049-378
N78-21814
NR PROJ. 049-389
N78-21814
NR PROJ. 093-052
N78-21240
NR PROJ. 201-207
N78-21759
NR PROJ. 213-155
N78-21387
NR PROJ. 318-003
N78-21381
NSF APR-75-166666
N78-21660
NSF C-724 N78-21177
N78-21409
NSF C-984 N78-21408
NSF CHE-74-08535
N78-21243
NSF DMR-73-07600
N78-21236
NSF DSI-76-19623
N78-21985
NSF DSI-77-17202
N78-21988
NSF ENG-74-21258
N78-21502
NSF ENG-74-21259
N78-21499
NSF ENG-75-00570
N78-21498
NSF ENG-75-14847
N78-21824
NSF ERS-76-21353
N78-21713
NSF GI-43870 N78-21713
NSF MCS-75-03894A2
N78-21857
NSF MCS-76-07247
N78-21859
NSF MCS-76-08316
N78-21862
NSF MCS-76-09179
N78-21864
NSF MCS-76-20019
N78-21798
N78-21805
N78-21806
NSF MCS-76-23865
N78-21853
NSF MCS-76-81259
N78-21805
NSF OCE-76-01309
N78-21743
N78-21745
NSF OCE-76-04825
N78-21743
NSF SIA-74-21846
N78-21990

NSG-1080 N78-21326
NSG-1236 N78-21491
NSG-1301 N78-21889
NSG-2140 N78-21059
NSG-2149 N78-21092
NSG-3065 N78-21469
NSG-3153 N78-21406
NSG-5049 N78-21444
NSG-7391 N78-22012
N00014-67-A-0103-0003
N78-21797
N00014-67-C-0097-0020
N78-21865
N00014-69-A-0423
N78-21874
N00014-70-C-0294
N78-21238
N00014-71-C-0176
N78-21240
N00014-75-C-0062
N78-21456
N00014-75-C-0196
N78-21501
N00014-75-C-0267
N78-21805
N00014-75-C-0474
N78-21902
N00014-75-C-0475
N78-21960
N00014-75-C-0496
N78-21963
N00014-75-C-0555
N78-21194
N78-21856
N78-21878
N00014-75-C-0560
N78-21864
N00014-75-C-0561
N78-21879
N00014-75-C-0601
N78-21982
N00014-75-C-0648
N78-21381
N00014-75-C-0665
N78-21273
N00014-75-C-0816
N78-21814
N00014-75-C-0837
N78-21850
N00014-75-C-0860
N78-21499
N78-21502
N00014-75-C-0865
N78-21798
N78-21805
N78-21806
N00014-75-C-1042
N78-21962
N00014-75-C-1095
N78-21354
N00014-75-C-1175
N78-21450
N00014-76-C-0050
N78-21964
N00014-76-C-0060
N78-21504
N00014-76-C-0118
N78-21901
N00014-76-C-0253
N78-21146
N00014-76-C-0275
N78-21858
N00014-76-C-0278
N78-21859
N00014-76-C-0418
N78-21804
N78-21824
N00014-76-C-0475
N78-21855
N78-21875
N00014-76-C-0548
N78-21243
N00014-76-C-0616
N78-21757
N78-21759
N00014-76-C-0687
N78-21814
N00014-76-C-0734
N78-21449

N00014-76-C-0770
N78-21454
N00014-76-C-0790
N78-21498
N00014-76-C-0874
N78-21783
N00014-76-C-1116
N78-21974
N00014-76-C-1162
N78-21448
N00014-77-C-0085
N78-21381
N00014-77-C-0135
N78-21975
N00014-77-C-0178
N78-21387
N00014-77-C-0306
N78-21863
N78-21864
N78-21880
N00014-77-C-0360
N78-21873
N00014-77-C-0378
N78-21810
N00014-77-C-0542
N78-21961
N00014-77-F-0008
N78-21239
N00017-73-C-1418
N78-21419
N00019-76-C-0683
N78-21310
N00039-76-C-0240
N78-21383
N00039-76-C-0279
N78-21195
N00039-77-C-0255
N78-21787
N00173-76-C-0249
N78-21500
N00173-77-C-0138
N78-21915
N00173-77-C-0156
N78-21458
N61331-76-M4839
N78-21358
N62269-73-C-0906
N78-21068
N62269-77-C-0138
N78-21363
PHS GM-16895-08
N78-21880
RR0130801 N78-21239
RR0140941 N78-21348
RR0420401 N78-21873
SF3230241-B N78-21375
SRI PROJ. PYU-4529
N78-21901
SRI PROJ. 4432
N78-21672
N78-21673
SRI PROJ. 5389
N78-21449
W-31-109-ENG-38
N78-21505
N78-21644
N78-21916
W-7405-ENG-26
N78-21217
N78-21218
N78-21283
N78-21422
N78-21483
N78-21647
N78-21648
N78-21929
N78-21935
N78-21966
N78-21967
W-7405-ENG-36
N78-21201
N78-21709
N78-21789
N78-21816
N78-21906
N78-21917
W-7405-ENG-38
N78-21817

W-7405-ENG-48
N78-21285
N78-21286
N78-21322
N78-21368
N78-21393
N78-21622
N78-21623
N78-21631
N78-21635
N78-21636
N78-21650
N78-21710
N78-21867
N78-21903
N78-21928
N78-21936
N78-21986
WF52551718 N78-21738
XP54581091 N78-21375
XP54586002 N78-21383
ZR00001 N78-21299
ZR01102 N78-21299
177-52-89-00-72
N78-21568
177-89-BD-00-72
N78-21562
312-04-02 N78-21839
369-20-01 N78-21691
505-01-21 N78-21490
505-02-13-42 N78-21489
505-02-21-01 N78-21055
505-04 N78-21113
N78-21269
N78-21470
N78-21473
505-05 N78-21112
N78-21114
505-05-43-01 N78-21430
505-07-23-07 N78-21431
505-08-21 N78-21214
505-10-21 N78-21159
505-10-23-03 N78-21052
505-10-23-05 N78-21410
505-10-31 N78-21115
506-16 N78-21294
N78-21295
506-16-11 N78-21215
506-25 N78-21922
506-25-21-02-00
N78-21193
510-56-01 N78-21223
513-52-01-09 N78-21104
516-51-01 N78-21160
663-01-09 N78-21526
743-04-13-02 N78-21053
791-40-11 N78-21094
791-40-41 N78-21092
862-11-04 N78-21216
992-19-00-18 N78-21426

Typical Report/Accession Number Index Listing



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A-6613 ..... N78-21215*#
A-7024 ..... N78-21193*#
A-7338 ..... N78-21214*#
A-7364 ..... N78-21094*#
A-7367 ..... N78-21159*#
A-7380 ..... N78-21407*#
A-7418 ..... N78-21490*#

AAE-77-17 ..... N78-21302 #

AD-A047084 ..... N78-21065 #
AD-A047511 ..... N78-21696 #
AD-A047606 ..... N78-21457 #
AD-A047611 ..... N78-21706 #
AD-A047623 ..... N78-21241 #
AD-A047629 ..... N78-21389 #
AD-A048155 ..... N78-22001 #
AD-A048479 ..... N78-22013 #
AD-A048526 ..... N78-21739 #
AD-A049029 ..... N78-21170 #
AD-A049390 ..... N78-21390 #
AD-A049391 ..... N78-21280 #
AD-A049393 ..... N78-21117 #
AD-A049394 ..... N78-21788 #
AD-A049395 ..... N78-21862 #
AD-A049396 ..... N78-21861 #
AD-A049397 ..... N78-21860 #
AD-A049430 ..... N78-21728 #
AD-A049431 ..... N78-21727 #
AD-A049435 ..... N78-21726 #
AD-A049438 ..... N78-21045 #
AD-A049440 ..... N78-21165 #
AD-A049441 ..... N78-21748 #
AD-A049442 ..... N78-21348 #
AD-A049443 ..... N78-21497 #
AD-A049445 ..... N78-21614 #
AD-A049446 ..... N78-21844 #
AD-A049448 ..... N78-21697 #
AD-A049451 ..... N78-21349 #
AD-A049453 ..... N78-21845 #
AD-A049454 ..... N78-21820 #
AD-A049455 ..... N78-21350 #
AD-A049456 ..... N78-21351 #
AD-A049457 ..... N78-21779 #
AD-A049458 ..... N78-21352 #
AD-A049459 ..... N78-21097 #
AD-A049462 ..... N78-21353 #
AD-A049464 ..... N78-21780 #
AD-A049466 ..... N78-21781 #
AD-A049467 ..... N78-21797 #
AD-A049468 ..... N78-21782 #
AD-A049469 ..... N78-21270 #
AD-A049470 ..... N78-21236*#
AD-A049471 ..... N78-21303 #
AD-A049472 ..... N78-21793 #
AD-A049473 ..... N78-21794 #
AD-A049474 ..... N78-21795 #
AD-A049475 ..... N78-21796 #
AD-A049477 ..... N78-21798 #
AD-A049482 ..... N78-21773 #
AD-A049483 ..... N78-21774 #
AD-A049484 ..... N78-21775 #
AD-A049485 ..... N78-21777 #
AD-A049486 ..... N78-21778 #
AD-A049487 ..... N78-21776 #
AD-A049488 ..... N78-21615 #
AD-A049492 ..... N78-21828 #
AD-A049499 ..... N78-21302 #
AD-A049500 ..... N78-21821 #
AD-A049501 ..... N78-21846 #
AD-A049502 ..... N78-21971 #
AD-A049503 ..... N78-21698 #
AD-A049504 ..... N78-21446 #
AD-A049505 ..... N78-21923 #
AD-A049506 ..... N78-21375 #
AD-A049507 ..... N78-21738 #
AD-A049509 ..... N78-21447 #
AD-A049510 ..... N78-21194 #
AD-A049513 ..... N78-21960 #
AD-A049514 ..... N78-21354 #
AD-A049515 ..... N78-21699 #
AD-A049517 ..... N78-21304 #
AD-A049518 ..... N78-21882 #
AD-A049519 ..... N78-21883 #
AD-A049521 ..... N78-21414 #
AD-A049522 ..... N78-21162 #
AD-A049525 ..... N78-21067 #
AD-A049526 ..... N78-21847 #
AD-A049527 ..... N78-21848 #
AD-A049528 ..... N78-21224 #
AD-A049529 ..... N78-21271 #
AD-A049530 ..... N78-21884 #
AD-A049531 ..... N78-21305 #
AD-A049532 ..... N78-21783 #
AD-A049533 ..... N78-21822 #
AD-A049535 ..... N78-21415 #
AD-A049536 ..... N78-21784 #
AD-A049537 ..... N78-21307 #
AD-A049538 ..... N78-21225 #
AD-A049539 ..... N78-21277 #
AD-A049540 ..... N78-21455 #
AD-A049541 ..... N78-21830 #
AD-A049544 ..... N78-21963 #
AD-A049545 ..... N78-21978 #
AD-A049547 ..... N78-21925 #
AD-A049548 ..... N78-21877 #
AD-A049549 ..... N78-21364 #
AD-A049550 ..... N78-21905 #
AD-A049551 ..... N78-21456 #
AD-A049553 ..... N78-21808 #
AD-A049554 ..... N78-21809 #
AD-A049555 ..... N78-21240 #
AD-A049556 ..... N78-21878 #
AD-A049558 ..... N78-21915 #
AD-A049559 ..... N78-21786 #
AD-A049561 ..... N78-21195 #
AD-A049562 ..... N78-21893 #
AD-A049564 ..... N78-21913 #
AD-A049579 ..... N78-21098 #
AD-A049580 ..... N78-21163 #
AD-A049581 ..... N78-21355 #
AD-A049583 ..... N78-21448 #
AD-A049585 ..... N78-21498 #
AD-A049586 ..... N78-21799 #
AD-A049587 ..... N78-21800 #
AD-A049588 ..... N78-21801 #
AD-A049589 ..... N78-21802 #
AD-A049590 ..... N78-21803 #
AD-A049592 ..... N78-21823 #
AD-A049593 ..... N78-21804 #
AD-A049595 ..... N78-21824 #
AD-A049617 ..... N78-21849 #
AD-A049618 ..... N78-21873 #
AD-A049619 ..... N78-21356 #
AD-A049620 ..... N78-21060 #
AD-A049661 ..... N78-21239 #
AD-A049695 ..... N78-21962 #

AD-A049696 ..... N78-21972 #
AD-A049697 ..... N78-21454 #
AD-A049698 ..... N78-21379 #
AD-A049699 ..... N78-21363 #
AD-A049700 ..... N78-21853 #
AD-A049701 ..... N78-21852 #
AD-A049704 ..... N78-21854 #
AD-A049706 ..... N78-21770 #
AD-A049707 ..... N78-21874 #
AD-A049736 ..... N78-21341 #
AD-A049737 ..... N78-21340 #
AD-A049738 ..... N78-21357 #
AD-A049739 ..... N78-21344 #
AD-A049740 ..... N78-21345 #
AD-A049743 ..... N78-21066 #
AD-A049744 ..... N78-21272 #
AD-A049756 ..... N78-21805 #
AD-A049757 ..... N78-21806 #
AD-A049758 ..... N78-21863 #
AD-A049760 ..... N78-21866 #
AD-A049761 ..... N78-21814 #
AD-A049762 ..... N78-21902 #
AD-A049763 ..... N78-21383 #
AD-A049764 ..... N78-21278 #
AD-A049765 ..... N78-21382 #
AD-A049766 ..... N78-21419 #
AD-A049767 ..... N78-21068 #
AD-A049768 ..... N78-21578 #
AD-A049771 ..... N78-21865 #
AD-A049772 ..... N78-21420 #
AD-A049775 ..... N78-21879 #
AD-A049776 ..... N78-21346 #
AD-A049777 ..... N78-21347 #
AD-A049778 ..... N78-21702 #
AD-A049779 ..... N78-21381 #
AD-A049780 ..... N78-21504 #
AD-A049781 ..... N78-21810 #
AD-A049782 ..... N78-21787 #
AD-A049783 ..... N78-21864 #
AD-A049784 ..... N78-21880 #
AD-A049794 ..... N78-21666 #
AD-A049795 ..... N78-21358 #
AD-A049796 ..... N78-21297 #
AD-A049797 ..... N78-21981 #
AD-A049798 ..... N78-21825 #
AD-A049825 ..... N78-21416 #
AD-A049827 ..... N78-21499 #
AD-A049829 ..... N78-21449 #
AD-A049846 ..... N78-21982 #
AD-A049848 ..... N78-21273 #
AD-A049854 ..... N78-21274 #
AD-A049856 ..... N78-21474 #
AD-A049858 ..... N78-21450 #
AD-A049859 ..... N78-21105 #
AD-A049862 ..... N78-21166 #
AD-A049864 ..... N78-21811 #
AD-A049865 ..... N78-21242 #
AD-A049866 ..... N78-21502 #
AD-A049868 ..... N78-21859 #
AD-A049869 ..... N78-21813 #
AD-A049872 ..... N78-21243 #
AD-A049876 ..... N78-21102 #
AD-A049917 ..... N78-21812 #
AD-A049919 ..... N78-21740 #
AD-A049926 ..... N78-21182 #
AD-A049927 ..... N78-21476 #
AD-A049933 ..... N78-21703 #
AD-A049936 ..... N78-21724 #
AD-A049937 ..... N78-21384 #
AD-A049938 ..... N78-21385 #
AD-A049942 ..... N78-21308 #
AD-A049943 ..... N78-21617 #
AD-A049945 ..... N78-21964 #
AD-A049950 ..... N78-21386 #
AD-A049951 ..... N78-21704 #
AD-A049954 ..... N78-21975 #
AD-A049958 ..... N78-21705 #
AD-A049969 ..... N78-21309 #
AD-A049971 ..... N78-21858 #
AD-A049973 ..... N78-21169 #
AD-A049975 ..... N78-21279 #
AD-A049976 ..... N78-21984 #
AD-A049979 ..... N78-21168 #
AD-A049980 ..... N78-21378 #
AD-A049981 ..... N78-21101 #
AD-A049983 ..... N78-21418 #
AD-A049984 ..... N78-21758 #
AD-A049986 ..... N78-21855 #
AD-A049989 ..... N78-21875 #
AD-A049992 ..... N78-21829 #

AD-A049995 ..... N78-21856 #
AD-A049996 ..... N78-21876 #
AD-A049999 ..... N78-21973 #
AD-A050000 ..... N78-21213 #
AD-A050001 ..... N78-21857 #
AD-A050003 ..... N78-21298 #
AD-A050004 ..... N78-21380 #
AD-A050005 ..... N78-21723 #
AD-A050020 ..... N78-21417 #
AD-A050021 ..... N78-21892 #
AD-A050024 ..... N78-21577 #
AD-A050025 ..... N78-21061 #
AD-A050026 ..... N78-21616 #
AD-A050027 ..... N78-21701 #
AD-A050029 ..... N78-21757 #
AD-A050030 ..... N78-21961 #
AD-A050031 ..... N78-21501 #
AD-A050033 ..... N78-21769 #
AD-A050035 ..... N78-21725 #
AD-A050037 ..... N78-21901 #
AD-A050040 ..... N78-21759 #
AD-A050049 ..... N78-21460 #
AD-A050051 ..... N78-21310 #
AD-A050052 ..... N78-21729 #
AD-A050053 ..... N78-21281 #
AD-A050054 ..... N78-21461 #
AD-A050055 ..... N78-21282 #
AD-A050056 ..... N78-21311 #
AD-A050057 ..... N78-21462 #
AD-A050058 ..... N78-21850 #
AD-A050059 ..... N78-21164 #
AD-A050060 ..... N78-21721 #
AD-A050071 ..... N78-21167 #
AD-A050072 ..... N78-21171 #
AD-A050073 ..... N78-21365 #
AD-A050074 ..... N78-21366 #
AD-A050075 ..... N78-21459 #
AD-A050076 ..... N78-21503 #
AD-A050077 ..... N78-21367 #
AD-A050078 ..... N78-21771 #
AD-A050080 ..... N78-21432 #
AD-A050083 ..... N78-21914 #
AD-A050089 ..... N78-21451 #
AD-A050090 ..... N78-21306 #
AD-A050092 ..... N78-21275 #
AD-A050093 ..... N78-21924**
AD-A050094 ..... N78-21452 #
AD-A050096 ..... N78-21983 #
AD-A050097 ..... N78-21453 #
AD-A050098 ..... N78-21237 #
AD-A050099 ..... N78-21359 #
AD-A050100 ..... N78-21826 #
AD-A050101 ..... N78-21851 #
AD-A050112 ..... N78-21376 #
AD-A050118 ..... N78-21360 #
AD-A050119 ..... N78-21785 #
AD-A050120 ..... N78-21500 #
AD-A050122 ..... N78-21433 #
AD-A050123 ..... N78-21475 #
AD-A050125 ..... N78-21377 #
AD-A050132 ..... N78-21361 #
AD-A050133 ..... N78-21238 #
AD-A050142 ..... N78-21755 #
AD-A050143 ..... N78-21342 #
AD-A050144 ..... N78-21343 #
AD-A050152 ..... N78-21099 #
AD-A050160 ..... N78-21576 #
AD-A050161 ..... N78-21186 #
AD-A050162 ..... N78-21700 #
AD-A050163 ..... N78-21362 #
AD-A050164 ..... N78-21100 #
AD-A050185 ..... N78-21391 #
AD-A050211 ..... N78-21756 #
AD-A050212 ..... N78-21276 #
AD-A050213 ..... N78-21827 #
AD-A050244 ..... N78-21807 #
AD-A050245 ..... N78-21722 #
AD-A050246 ..... N78-21482 #
AD-A050252 ..... N78-21296 #
AD-A050296 ..... N78-21959 #
AD-A050413 ..... N78-21764 #
AD-A050461 ..... N78-21765 #
AD-A050475 ..... N78-21387 #
AD-A050476 ..... N78-21388 #
AD-A050478 ..... N78-21299 #
AD-A050480 ..... N78-21458 #
AD-A050922 ..... N78-21754 #
AD-A050923 ..... N78-21234 #
AD-A050978 ..... N78-21335 #

AD-A051002 ..... N78-21768 #

AD-E000075 ..... N78-21348 #
AD-E000076 ..... N78-21451 #
AD-E000077 ..... N78-21453 #
AD-E000078 ..... N78-21983 #
AD-E000079 ..... N78-21237 #
AD-E000083 ..... N78-21500 #
AD-E000088 ..... N78-21924*#
AD-E000092 ..... N78-21375 #
AD-E000093 ..... N78-21923 #
AD-E000094 ..... N78-21446 #
AD-E000095 ..... N78-21698 #
AD-E000096 ..... N78-21738 #
AD-E000097 ..... N78-21748 #
AD-E000099 ..... N78-21497 #
AD-E000100 ..... N78-21697 #
AD-E000103 ..... N78-21433 #
AD-E000108 ..... N78-21380 #
AD-E000110 ..... N78-21298 #
AD-E000115 ..... N78-21382 #
AD-E100013 ..... N78-21353 #
AD-E100019 ..... N78-21780 #
AD-E100024 ..... N78-21362 #
AD-E300086 ..... N78-21376 #
AD-E400035 ..... N78-21306 #
AD-E400066 ..... N78-21914 #
AD-E500014 ..... N78-21168 #

ADL-79299-F ..... N78-21666 #

AEOI-26 ..... N78-21662 #

AESC-5626 ..... N78-21387 #

AFAL-TR-77-162 ..... N78-21067 #
AFAL-TR-77-190 ..... N78-21105 #

AFAPL-TR-77-45 ..... N78-21384 #

AFCEC-TR-76-27-VOL-2 ..... N78-21170 #
AFCEC-TR-78-1 ..... N78-21165 #

AFFDL-TR-77-92 ..... N78-21101 #

AFGL-ERP-610 ..... N78-21700 #

AFGL-TR-77-0195 ..... N78-21706 #
AFGL-TR-77-0222 ..... N78-22013 #
AFGL-TR-77-0235 ..... N78-21700 #

AFHRL-TR-77-57 ..... N78-21770 #

AFIT-CI-78-25 ..... N78-21703 #
AFIT-CI-78-28 ..... N78-21724 #
AFIT-CI-78-29 ..... N78-21723 #
AFIT-CI-78-32 ..... N78-21721 #

AFIT-TR-77-6 ..... N78-21854 #

AFML-TR-77-67 ..... N78-21272 #

AFOSR-77-1291TR ..... N78-21241 #
AFOSR-77-1293TR ..... N78-21808 #
AFOSR-77-1294TR ..... N78-21809 #
AFOSR-77-1300TR ..... N78-21271 #
AFOSR-77-1302TR ..... N78-21213 #
AFOSR-77-1303TR ..... N78-21352 #
AFOSR-77-1304TR ..... N78-21844 #
AFOSR-77-1309TR ..... N78-21699 #
AFOSR-77-1310TR ..... N78-21307 #
AFOSR-77-1311TR ..... N78-21415 #
AFOSR-77-1312TR ..... N78-21225 #
AFOSR-77-1313TR ..... N78-21277 #
AFOSR-78-0003TR ..... N78-21447 #
AFOSR-78-0009TR ..... N78-21304 #
AFOSR-78-0010TR ..... N78-21303 #
AFOSR-78-0012TR ..... N78-21162 #
AFOSR-78-0013TR ..... N78-21845 #
AFOSR-78-0014TR ..... N78-21820 #
AFOSR-78-0015TR ..... N78-21784 #
AFOSR-78-0016TR ..... N78-21847 #
AFOSR-78-0017TR ..... N78-21786 #
AFOSR-78-0018TR ..... N78-21883 #
AFOSR-78-0019TR ..... N78-21882 #
AFOSR-78-0020TR ..... N78-21884 #
AFOSR-78-0021TR ..... N78-21822 #
AFOSR-78-0023TR ..... N78-21455 #

AFOSR-78-0024TR ..... N78-21830 #
AFOSR-78-0025TR ..... N78-21821 #
AFOSR-78-0026TR ..... N78-21414 #
AFOSR-78-0027TR ..... N78-21846 #
AFOSR-78-0029TR ..... N78-21305 #
AFOSR-78-0030TR ..... N78-21848 #
AFOSR-78-0031TR ..... N78-21224 #
AFOSR-78-0032TR ..... N78-21783 #
AFOSR-78-0033TR ..... N78-21925 #
AFOSR-78-0034TR ..... N78-21361 #
AFOSR-78-0041TR ..... N78-21876 #
AFOSR-78-0043TR ..... N78-21829 #
AFOSR-78-0045TR ..... N78-21857 #
AFOSR-78-0057TR-VOL-2 ..... N78-21167 #
AFOSR-78-0058TR-VOL-1 ..... N78-21171 #
AFOSR-78-0059TR ..... N78-21367 #
AFOSR-78-0061TR ..... N78-21311 #
AFOSR-78-0062TR ..... N78-21418 #
AFOSR-78-0063TR ..... N78-21758 #
AFOSR-78-0066TR ..... N78-21973 #
AFOSR-78-0067TR ..... N78-21282 #
AFOSR-78-0068TR ..... N78-21461 #
AFOSR-78-0069TR ..... N78-21281 #
AFOSR-78-0070TR ..... N78-21460 #
AFOSR-78-0072TR-PT-1 ..... N78-21365 #
AFOSR-78-0073TR-PT-2 ..... N78-21366 #
AFOSR-78-0077TR ..... N78-21459 #
AFOSR-78-0078TR ..... N78-21503 #
AFOSR-78-0079TR ..... N78-21276 #
AFOSR-78-0080TR ..... N78-21771 #
AFOSR-78-0101TR ..... N78-21342 #
AFOSR-78-0101TR-PT-2 ..... N78-21343 #
AFOSR-78-0102TR ..... N78-21755 #
AFOSR-78-0103TR ..... N78-21360 #
AFOSR-78-0104TR ..... N78-21359 #
AFOSR-78-0112TR ..... N78-21959 #
AFOSR-78-0116TR ..... N78-21785 #
AFOSR-78-0121TR ..... N78-21851 #
AFOSR-78-0125TR ..... N78-21756 #
AFOSR-78-0127TR ..... N78-21826 #
AFOSR-78-0192TR ..... N78-21764 #
AFOSR-78-0194TR ..... N78-21765 #

AFRPL-TR-77-85 ..... N78-21355 #

AFWL-TR-77-123 ..... N78-21349 #
AFWL-TR-77-167 ..... N78-21388 #

AGARD-CP-220 ..... N78-21071 #
AGARD-CP-229 ..... N78-21118 #

AGARD-HIGHLIGHTS-78/1 ..... N78-21046 #

AIAA-78-665 ..... N78-21205*#

AIM-302 ..... N78-21814 #

AIRESEARCH-77-14376 ..... N78-21097 #

AMMRC-CTR-77-30 ..... N78-21279 #

AMS-1302 ..... N78-21308 #
AMS-1359 ..... N78-21311 #

AN-OSTA-78-A ..... N78-21991*#

ANL-AMD-TM-305 ..... N78-21817 #

AOML-27 ..... N78-21421 #

AR-1 ..... N78-21279 #
AR-1 ..... N78-21297 #
AR-26 ..... N78-22018 #
AR-000-669 ..... N78-21747

ARAP-319 ..... N78-21307 #

ARC-47-6102 ..... N78-21309 #

ARCSL-TR-78001 ..... N78-21914 #

ARL-77-5/AFOSR-77-5 ..... N78-21765 #
ARL-77-7/AFOSR-77-6 ..... N78-21764 #
ARL-77-9/AFOSR-77-8 ..... N78-21756 #
ARL-77-14/AFOSR-77-12 ..... N78-21771 #

ARL/ME-NOTE-357 ..... N78-21054 #

ARLCD-SP-77005 ..... N78-21306 #

ARO-ITR-77-2 ..... N78-21432 #

ARO-11889.2-E ..... N78-21476 #
ARO-12290.8-E ..... N78-21432 #
ARO-12414.2-M ..... N78-21853 #
ARO-12640.20-M ..... N78-21971 #
ARO-12800.1-MSI ..... N78-21278 #
ARO-12821.2-MS ..... N78-21274 #
ARO-13022.1-EL ..... N78-21389 #
ARO-13149.4-M ..... N78-21877 #
ARO-13212.1-A-EL ..... N78-21905 #
ARO-13331.1-EL ..... N78-21350 #
ARO-13331.2-EL ..... N78-21351 #
ARO-14026.1-EX ..... N78-21420 #
ARO-14244.1-M ..... N78-21852 #
ARO-14435.7-M ..... N78-21855 #
ARO-14435.8-M ..... N78-21875 #
ARO-14435.13-M ..... N78-21856 #

ASD-TR-77-76 ..... N78-21066 #

ASRC-SUNY-PUB-419 ..... N78-21618 #
ASRC-SUNY-PUB-420 ..... N78-21657 #

ATR-78(8209)-1 ..... N78-21233 #

AVSD-0041-77-CR ..... N78-22007*#

AWS-TR-77-273 ..... N78-21725 #

BBC-RD-1978/7 ..... N78-21332

BBN-3742 ..... N78-21810 #

BDX-613-1566 ..... N78-21435 #

BEBC/PPS-77/5 ..... N78-21324 #

BH-OFR-1-78 ..... N78-21585 #

BNL-22969 ..... N78-21633 #
BNL-50633 ..... N78-21634 #

BNWL-TR-254 ..... N78-21246 #

BNWL-2107 ..... N78-21671 #
BNWL-2311 ..... N78-21649 #

BSR-4188 ..... N78-21401 #
BSR-4230 ..... N78-21402 #

CA-DOT-TL-7218-1-76-23 ..... N78-21676 #

CAC361B ..... N78-21975 #

CASD-NAS-78-005 ..... N78-21175*#

CEEDO-TR-77-44-VOL-2 ..... N78-21170 #

CERL-TR-C-76-VOL-2 ..... N78-21170 #

CERL-TR-E-126-VOL-1 ..... N78-21813 #

CISR-P010-01-06 ..... N78-21787 #

CN-ISSN-0082-5263 ..... N78-21405 #

CNA-130 ..... N78-21858 #

CONF-770331-3 ..... N78-21424 #
CONF-770537-9 ..... N78-21285 #
CONF-770609-5 ..... N78-21622 #
CONF-770632 ..... N78-21644 #
CONF-770692-2 ..... N78-21867 #
CONF-770706 ..... N78-21286 #
CONF-770722-2 ..... N78-21968 #
CONF-770742-1 ..... N78-21633 #
CONF-770807-34 ..... N78-21505 #
CONF-770868-2 ..... N78-21916 #
CONF-770870-1 ..... N78-21647 #
CONF-770870-2 ..... N78-21648 #
CONF-770902-5 ..... N78-21483 #
CONF-770908-6 ..... N78-21966 #
CONF-770937-3 ..... N78-21986 #
CONF-770955-2 ..... N78-21218 #
CONF-771015-6-1 ..... N78-21636 #
CONF-771023-5 ..... N78-21789 #
CONF-771029-49 ..... N78-21928 #
CONF-771040-5 ..... N78-21917 #
CONF-771120-4 ..... N78-21625 #
CONF-771132-1 ..... N78-21393 #

CONS/9427-1 ..... N78-21472*#

CONTRIB-77-004 ..... N78-21745 #

CONTU-77-0013 ..... N78-21987 #

COO-0003-8 ..... N78-21316 #
COO-0003-10 ..... N78-21317 #
COO-2486-366 ..... N78-21760 #
COO-2597-3 ..... N78-21624 #
COO-2619-1 ..... N78-21651 #
COO-2641-4 ..... N78-21424 #
COO-2749-18 ..... N78-21479 #
COO-2923-3 ..... N78-21625 #

COO-2939-1 ..... N78-21645 #
COO-2991-17 ..... N78-21321 #
COO-4210-1-SUMM ..... N78-21638 #
COO-4212-1/1-VOL-1 ..... N78-21639 #
COO-4214-1/1-VOL-1 ..... N78-21641 #
COO-4272-1 ..... N78-21245 #

CRC-APRAC-CAPA-12-72 ..... N78-21712 #

CRC-1313 ..... N78-21334 #
CRC-1315-E N78-21689

CRESS-19 ..... N78-21713 #

CSC-TR-617 ..... N78-21823 #

CSIR-TR-4 ..... N78-21787 #

DCEC-TN-24-77 ..... N78-21780 #

DNA-4406T ..... N78-21376 #

DOC-77SDS4222 ..... N78-21512*#
DOC-77SDS4258 ..... N78-21511*#

DOE-TR-15 ..... N78-21425 #

DOE/JPL-1012-78/3 ..... N78-21600*#
DOE/JPL-1060-78/1 ..... N78-21599*#

DOT-HS-803-183 ..... N78-21314 #
DOT-HS-803-184 ..... N78-21315 #

DOT-TSC-OST-76-57 ..... N78-21681 #

DR-944 ..... N78-21726 #
DR-945 ..... N78-21728 #
DR-946 ..... N78-21727 #

DSE/2460-2 ..... N78-21646 #

DTNSRDC-TM-184-78-02 ..... N78-21981 #

DTNSRDC/ASED-389 ..... N78-21060 #

D180-24613-1 ..... N78-21493*#
D180-24613-2 ..... N78-21494*#
D210-11025-1 ..... N78-21098 #

E-651-78-01 ..... N78-21191*#
E-9192 ..... N78-21190*#
E-9238 ..... N78-21220*#
E-9257 ..... N78-21112*#
E-9260 ..... N78-21470*#
E-9278 ..... N78-21202*#
E-9307 ..... N78-21294*#
E-9340 ..... N78-21113*#
E-9350 ..... N78-21473*#
E-9360 ..... N78-21295*#
E-9386 ..... N78-21922*#
E-9387 ..... N78-21114*#
E-9414 ..... N78-21269*#
E-9455 ..... N78-21199*#
E-9489 ..... N78-21108*#
E-9503 ..... N78-21441*#
E-9505 ..... N78-21109*#
E-9508 ..... N78-21221*#
E-9524 ..... N78-21596*#
E-9526 ..... N78-21372*#
E-9535 ..... N78-21110*#

E-9536 ..... N78-21373*#
E-9540 ..... N78-21403*#
E-9544 ..... N78-21266*#
E-9557 ..... N78-21404*#
E-9571 ..... N78-21206*#
E-9579 ..... N78-21791*#
E-9581 ..... N78-21207*#
E-9584 ..... N78-21205*#
E-9589 ..... N78-21204*#
E-9590 ..... N78-21208*#
E-9592 ..... N78-21203*#
E-9594 ..... N78-21188*#
E-9599 ..... N78-21209*#

ECAC-PR-77-049 ..... N78-21335 #

ECON-4525 ..... N78-21781 #
ECON-4526 ..... N78-21782 #
ECON-4527 ..... N78-21779 #
ECON-4528-VOL-3 ..... N78-21773 #
ECON-4529-VOL-4 ..... N78-21774 #
ECON-4530-VOL-5 ..... N78-21775 #
ECON-4531-VOL-8 ..... N78-21777 #
ECON-4532-VOL-9 ..... N78-21778 #
ECON-4535-VOL-6 ..... N78-21776 #
ECON-5832 ..... N78-21701 #

ECRC/M-1034 ..... N78-21287 #

ED-JF-5 ..... N78-21525*#

EDM-1028 ..... N78-21607 #

EHD-78-10 ..... N78-21313 #

EHEO-PED-TM-77-1 ..... N78-21364 #

EP-04122656 ..... N78-21435 #

EPA-430/1-77-006 ..... N78-21675 #
EPA-430/1-77-010 ..... N78-21674 #
EPA-450/3-77-022B-VOL-2 ..... N78-21672 #
EPA-450/3-77-022C-VOL-3 ..... N78-21673 #
EPA-600/2-77-209B ..... N78-21682 #
EPA-600/2-77-220 ..... N78-21436 #
EPA-600/3-77-113 ..... N78-21679 #
EPA-600/3-77-127 ..... N78-21247 #
EPA-600/5-77-015A-VOL-1 ..... N78-21992 #
EPA-600/5-77-015B-VOL-2 ..... N78-21993 #
EPA-600/7-77-060 ..... N78-21668 #
EPA-600/7-77-084 ..... N78-21667 #
EPA-600/7-77-116 ..... N78-21680 #
EPA-600/7-77-119A-VOL-1 ..... N78-21677 #
EPA-600/7-77-119B-VOL-2 ..... N78-21678 #
EPA-600/7-77-127 ..... N78-21670 #
EPA-600/7-77-128 ..... N78-21248 #
EPA-600/7-77-142 ..... N78-21325 #
EPA-600/9-77-019 ..... N78-21661 #

EPRI-EA-433-VOL-1 ..... N78-21637 #

EPRI-EL-537 ..... N78-21392 #

EPRI-ER-352 ..... N78-21630 #
EPRI-ER-429-SR-PT-A ..... N78-21927 #
EPRI-ER-429-SR-PT-B ..... N78-21927 #
EPRI-ER-429-SR-PT-C ..... N78-21927 #
EPRI-ER-544 ..... N78-21926 #

EPRI-NP-160-VOL-1 ..... N78-21478 #
EPRI-NP-170 ..... N78-21477 #

ER-190-25 ..... N78-21235*#
ER-2602 ..... N78-21474 #

ERDA-TR-311 ..... N78-21931 #
ERDA-TR-312 ..... N78-21932 #
ERDA-TR-313 ..... N78-21933 #
ERDA-TR-314 ..... N78-21934 #

ERG-018 ..... N78-21608 #

ERHQ-0015 ..... N78-21318 #

ERIM-120000-15-F ..... N78-21524*#

ER78-4035 ..... N78-21099 #
ER77-4109-VOL-1 ..... N78-21346 #
ER77-4109-VOL-2 ..... N78-21347 #

ESD-TR-77-276 ..... N78-22001 #
ESD-TR-77-279 ..... N78-21576 #
ESD-TR-77-336 ..... N78-21186 #
ESD-TR-268 ..... N78-21391 #

ESL-R-803 ..... N78-21838*#

ESL-4311-2 ..... N78-21350 #
ESL-4311-6 ..... N78-21351 #
ESL-784650-3 ..... N78-21337*#

ETL-0130 ..... N78-21577 #
ETL-0132 ..... N78-21379 #

ETS-21 ..... N78-22001 #

E78-10101 ..... N78-21509*#
E78-10104 ..... N78-21510*#
E78-10105 ..... N78-21511*#
E78-10106 ..... N78-21512*#
E78-10107 ..... N78-21513*#
E78-10108 ..... N78-21514*#
E78-10109 ..... N78-21515*#
E78-10111 ..... N78-21516*#
E78-10112 ..... N78-21517*#
E78-10113 ..... N78-21518*#
E78-10114 ..... N78-21519*#
E78-10115 ..... N78-21520*#
E78-10116 ..... N78-21521*#
E78-10118 ..... N78-21522*#
E78-10119 ..... N78-21523*#
E78-10120 ..... N78-21528*#

FAA-AM-78-2 ..... N78-21754 #
FAA-AM-78-4 ..... N78-21768 #

FAA-RD-76-223 ..... N78-21893 #
FAA-RD-77-99 ..... N78-21234 #
FAA-RD-77-115 ..... N78-21111*#
FAA-RD-77-126 ..... N78-21335 #
FAA-RD-77-147 ..... N78-21097 #

FAA-77-25 ..... N78-21893 #

FE-1534-49 ..... N78-21320 #
FE-2203-16 ..... N78-21319 #
FE-2290-26 ..... N78-21480 #
FE-2352-03 ..... N78-21632 #
FE-2556-06 ..... N78-21423 #

FEA/G-77/059 ..... N78-21580 #

FFA-TN-AU-725 ..... N78-21062 #

FHWA/NJ-77-003A ..... N78-21327 #
FHWA/RD-77-74 ..... N78-21676 #

FPR-25 ..... N78-21236*#

FR-2 ..... N78-21359 #
FR-9489 ..... N78-21270 #

FTD-ID(RS)T-1249-77 ..... N78-21117 #
FTD-ID(RS)T-1291-77 ..... N78-21390 #
FTD-ID(RS)T-1326-77 ..... N78-21788 #
FTD-ID(RS)T-1552-77 ..... N78-21280 #

FWS/OBS-77/35 ..... N78-21579 #

G-7702-F22 ..... N78-21200*#
G-7719 ..... N78-21526*#
G-97802-F9 ..... N78-21216*#

GASL-TR-246 ..... N78-21213 #

GCA-TR-75-17-G ..... N78-21667 #

GER-16523 ..... N78-21379 #

GL-2736 ..... N78-21455 #
GL-2760 ..... N78-21959 #

GPO-91-591 ..... N78-21891 #
GPO-93-810 ..... N78-21613 #
GPO-94-365 ..... N78-21610 #

G7802-F11 ..... N78-21691*#

H-940 ..... N78-21160*#
H-1010 ..... N78-21839*#

HONEYWELL-77SRC93 ..... N78-21913 #

HRD-78-23 ..... N78-21976 #

HRL-CS-1 ..... N78-21352 #

IBM-7933252 ..... N78-21595*#

ICAF-995 ..... N78-21492 #

ID-78-4 ..... N78-21619 #

IITRI-J6352-2 ..... N78-21305 #

INPE-1112-TPT/065 ..... N78-21510*#
INPE-1157-TPT/072 ..... N78-21514*#
INPE-1178-TPT/079 ..... N78-21513*#

IR-2 ..... N78-21300 #

ISBN-0-626-04016-7 ..... N78-21467
ISBN-0-626-04306-9 ..... N78-21262
ISBN-0-626-04425-1 ..... N78-21264
ISBN-0-626-04477-4 ..... N78-21263
ISBN-92-835-0209-4 ..... N78-21118 #
ISBN-92-835-0211-6 ..... N78-21071 #

ISL-R-103/77 ..... N78-21749 #

ISSN-0305-1315 ..... N78-21328 #
ISSN-0305-1315 ..... N78-21658 #

ITT-FLUIDS/HEATTRANS-R77-2 ..... N78-21432 #

JCAP-DM-T705 ..... N78-21972 #

JPL-PUB-77-70 ..... N78-21173*#
JPL-PUB-77-81 ..... N78-21664*#
JPL-PUB-77-82 ..... N78-21598*#
JPL-PUB-77-83 ..... N78-21569*#
JPL-PUB-78-10-VOL-1 ..... N78-21599*#
JPL-PUB-78-13 ..... N78-21600*#
JPL-PUB-78-15-VOL-1 ..... N78-21601*#
JPL-PUB-78-16 ..... N78-21057*#
JPL-PUB-78-20 ..... N78-21333*#

JPRS-70928 ..... N78-21761 #
JPRS-70946 ..... N78-21183 #

JSC-12897 ..... N78-21568*#

JTCG/AS-75-S-002 ..... N78-21099 #

KU-FRL-317-6 ..... N78-21889*#

L-11920 ..... N78-21431*#
L-11980 ..... N78-21410*#
L-11984 ..... N78-21055*#
L-11988 ..... N78-21430*#

LA-UR-77-2222 ..... N78-21917 #
LA-UR-2383 ..... N78-21789 #

LA-6930-MS ..... N78-21709 #
LA-6965-MS ..... N78-21201 #
LA-7003-PR ..... N78-21906 #

LBL-6332 ..... N78-21710 #
LBL-6337 ..... N78-21622 #
LBL-6369 ..... N78-21631 #
LBL-6662 ..... N78-21903 #
LBL-6831-VOL-1 ..... N78-21623 #
LBL-6831-VOL-2 ..... N78-21635 #
LBL-6841 ..... N78-21636 #

LC-77-25922 ..... N78-21174*#
LC-77-90963 ..... N78-21579 #
LC-77-608309 ..... N78-21819 #

LCD-78-212 ..... N78-21977 #

LEC-11087 ..... N78-21574*#
LEC-11783 ..... N78-21338*#

LMSC-D566093 ..... N78-21461 #

LR-28283 ..... N78-21095*#

M-248 ..... N78-21189*#
M-249 ..... N78-21717*#
M-251 ..... N78-21665*#

MAN-1023-B ..... N78-21890*#

MCR-74-107-REV-1 ..... N78-21792*#
MCR-78-512 ..... N78-21197*#
MCR-78-523 ..... N78-21301*#

MDC-E1729-VOL-1 ..... N78-21442*#
MDC-E1729-VOL-2 ..... N78-21443*#

MDC-J7171 ..... N78-21101 #
MDC-J7471 ..... N78-21223*#
MDC-J7733 ..... N78-21047*#

MDC-Q0616 ..... N78-21358 #

MHSRP-77-56 ..... N78-21434 #

MML-TR-77-71C ..... N78-21699 #
MML-TR-77-72C ..... N78-21310 #

MRC-TSR-1775 ..... N78-21862 #
MRC-TSR-1787 ..... N78-21861 #
MRC-TSR-1790 ..... N78-21860 #
MRC-TSR-1809 ..... N78-21828 #

MRL-MR-3647 ..... N78-21453 #

MRL-R-698 ..... N78-21747

MR176-PR-1868 ..... N78-21680 #

MSC/TPR/806/1025 ..... N78-21219*#

M75(AS)-4 ..... N78-21659 #

NA-77-729 ..... N78-21105 #

NADC-76240-20 ..... N78-21363 #
NADC-77287-60 ..... N78-21100 #

NASA-CP-6 ..... N78-21526*#
NASA-CP-2030 ..... N78-21562*#

NASA-CR-2949 ..... N78-21058*#
NASA-CR-2963 ..... N78-21406*#
NASA-CR-2967 ..... N78-21059*#
NASA-CR-2968 ..... N78-21428*#
NASA-CR-2973 ..... N78-21429*#
NASA-CR-2976 ..... N78-21469*#
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NASA-CR-135348 ..... N78-21268*#
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NASA-CR-135370 ..... N78-21494*#
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NASA-CR-150587 ..... N78-21594*#
NASA-CR-150591 ..... N78-21591*#
NASA-CR-150606 ..... N78-21593*#
NASA-CR-150611 ..... N78-21602*#
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NASA-CR-150638 ..... N78-21210*#
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NASA-CR-151697 ..... N78-21841*#
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NASA-CR-151702 ..... N78-21753*#
NASA-CR-151951 ..... N78-21223*#
NASA-CR-152031 ..... N78-21590*#
NASA-CR-152093 ..... N78-21235*#
NASA-CR-152096 ..... N78-21095*#
NASA-CR-152115 ..... N78-21092*#
NASA-CR-152125 ..... N78-22000*#
NASA-CR-152133 ..... N78-21445*#
NASA-CR-152134 ..... N78-21115*#
NASA-CR-152135 ..... N78-21161*#
NASA-CR-152615 ..... N78-21525*#
NASA-CR-155963 ..... N78-21509*#
NASA-CR-156068 ..... N78-21928*#
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NASA-CR-156081 ..... N78-21521*#
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NASA-CR-156086 ..... N78-21523*#
NASA-CR-156087 ..... N78-21524*#
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NASA-CR-156127 ..... N78-21516*#
NASA-CR-156128 ..... N78-21518*#
NASA-CR-156149 ..... N78-21573*#
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NASA-CR-156151 ..... N78-21491*#
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NASA-CR-156163 ..... N78-21333*#
NASA-CR-156164 ..... N78-21664*#
NASA-CR-156165 ..... N78-21599*#
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NASA-CR-156167 ..... N78-21180*#
NASA-CR-156168 ..... N78-21569*#
NASA-CR-156169 ..... N78-21181*#
NASA-CR-156170 ..... N78-21889*#
NASA-CR-156171 ..... N78-21326*#
NASA-CR-156180 ..... N78-21598*#
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NASA-CR-156718 ..... N78-21512*#
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NASA-CR-156728 ..... N78-21443*#
NASA-CR-156730 ..... N78-21336*#
NASA-CR-156732 ..... N78-21427*#
NASA-CR-156733 ..... N78-22007*#
NASA-CR-156734 ..... N78-21337*#
NASA-CR-156735 ..... N78-21720*#
NASA-CR-156736 ..... N78-22016*#
NASA-CR-156737 ..... N78-21719*#
NASA-CR-156739 ..... N78-21606*#
NASA-CR-156743 ..... N78-21339*#

NASA-NEWS-RELEASE-78-60 ..... N78-21507*

NASA-RP-1016 ..... N78-21568*#

NASA-SP-362 ..... N78-21174*#
NASA-SP-7011(178) ..... N78-21750*+
NASA-SP-8124 ..... N78-21211*#

NASA-TM-72854 ..... N78-21839*#
NASA-TM-73668 ..... N78-21190*#
NASA-TM-73733 ..... N78-21202*#
NASA-TM-73771 ..... N78-21220*#
NASA-TM-73774 ..... N78-21791*#
NASA-TM-73803 ..... N78-21205*#
NASA-TM-73865 ..... N78-21199*#
NASA-TM-73880 ..... N78-21108*#
NASA-TM-73888 ..... N78-21441*#
NASA-TM-73889 ..... N78-21372*#
NASA-TM-73890 ..... N78-21109*#
NASA-TM-73891 ..... N78-21221*#
NASA-TM-73897 ..... N78-21596*#
NASA-TM-74070 ..... N78-21489*#
NASA-TM-74092 ..... N78-21049*#
NASA-TM-75087 ..... N78-21570*#
NASA-TM-75088 ..... N78-21575*#
NASA-TM-75093 ..... N78-21571*#
NASA-TM-75096 ..... N78-21176*#
NASA-TM-75097 ..... N78-21192*#
NASA-TM-75195 ..... N78-21957*#
NASA-TM-75209 ..... N78-21212*#
NASA-TM-75241 ..... N78-21411*#
NASA-TM-75243 ..... N78-21412*#
NASA-TM-75250 ..... N78-21958*#
NASA-TM-75258 ..... N78-21231*#
NASA-TM-75260 ..... N78-21904*#
NASA-TM-75271 ..... N78-21232*#
NASA-TM-75272 ..... N78-21048*#
NASA-TM-75278 ..... N78-21413*#
NASA-TM-75281 ..... N78-21172*#
NASA-TM-75285 ..... N78-21751*#
NASA-TM-75290 ..... N78-21900*#
NASA-TM-78069 ..... N78-21694*#
NASA-TM-78116 ..... N78-21695*#
NASA-TM-78137 ..... N78-21189*#
NASA-TM-78163 ..... N78-21597*#
NASA-TM-78164 ..... N78-21198*#
NASA-TM-78165 ..... N78-21605*#
NASA-TM-78168 ..... N78-21495*#
NASA-TM-78468 ..... N78-21214*#
NASA-TM-78474 ..... N78-21094*#
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NASA-TM-78477 ..... N78-21407*#
NASA-TM-78483 ..... N78-21215*#
NASA-TM-78485 ..... N78-21490*#
NASA-TM-78657 ..... N78-21107*#
NASA-TM-78665 ..... N78-21050*#
NASA-TM-78671 ..... N78-21052*#
NASA-TM-78682 ..... N78-21056*#
NASA-TM-78683 ..... N78-21051*#
NASA-TM-78692 ..... N78-21104*#
NASA-TM-78707 ..... N78-21426*#
NASA-TM-78828 ..... N78-21267*#
NASA-TM-78830 ..... N78-21110*#
NASA-TM-78831 ..... N78-21373*#
NASA-TM-78833 ..... N78-21403*#
NASA-TM-78834 ..... N78-21266*#
NASA-TM-78843 ..... N78-21404*#
NASA-TM-78850 ..... N78-21206*#
NASA-TM-78855 ..... N78-21207*#
NASA-TM-78858 ..... N78-21203*#
NASA-TM-78859 ..... N78-21204*#
NASA-TM-78860 ..... N78-21208*#
NASA-TM-78863 ..... N78-21188*#
NASA-TM-78869 ..... N78-21209*#
NASA-TM-79429 ..... N78-21191*#
NASA-TM-79433 ..... N78-21840*#
NASA-TM-79434 ..... N78-21612*#
NASA-TM-79435 ..... N78-21179*#
NASA-TM-79436 ..... N78-21611*#
NASA-TM-79535 ..... N78-22017*#
NASA-TM-79730 ..... N78-22006*#

NASA-TP-1069 ..... N78-21112*#
NASA-TP-1120 ..... N78-21055*#
NASA-TP-1145 ..... N78-21200*#
NASA-TP-1168 ..... N78-21410*#
NASA-TP-1170 ..... N78-21430*#
NASA-TP-1177 ..... N78-21193*#
NASA-TP-1180 ..... N78-21160*#
NASA-TP-1185 ..... N78-21431*#
NASA-TP-1191 ..... N78-21294*#
NASA-TP-1193 ..... N78-21269*#
NASA-TP-1195 ..... N78-21113*#
NASA-TP-1198 ..... N78-21295*#
NASA-TP-1201 ..... N78-21922*#
NASA-TP-1202 ..... N78-21473*#
NASA-TP-1203 ..... N78-21470*#
NASA-TP-1205 ..... N78-21114*#
NASA-TP-1209 ..... N78-21737*#
NASA-TP-1212 ..... N78-21690*#
NASA-TP-1218 ..... N78-21216*#
NASA-TP-1223 ..... N78-21691*#

NASA-TT-F-16118 ..... N78-21177*#
NASA-TT-F-17059 ..... N78-21408*#
NASA-TT-F-17060 ..... N78-21409*#

NAVTRAEQUIPC-IH-287 ..... N78-21169 #

NBS-GCR-77-116 ..... N78-21244 #

NBS-SP-500-24 ..... N78-21819 #

NBS/GCR-77-109-REV ..... N78-21655 #

NBSIR-77-1396 ..... N78-21296 #

NEPP-III-A ..... N78-21669 #

NFAIS-77/3 ..... N78-21988 #

NHK-LABS-NOTE-213 ..... N78-21331
NHK-LABS-NOTE-214 ..... N78-21330

NLR-TR-76104-U ..... N78-21492 #

NMRC-KP-141 ..... N78-21741 #

NOAA-TM-ERL-MESA-17 ..... N78-21312 #

NOAA-TM-ERL-WMPO-40 ..... N78-21733 #
NOAA-TM-ERL-WMPO-41 ..... N78-21106 #

NOAA-TM-ERL-WPL-27 ..... N78-21711 #

NOAA-TM-NESS-90 ..... N78-21584 #
NOAA-TM-NESS-94 ..... N78-21732 #

NOAA-TR-ERL-386 ..... N78-21421 #
NOAA-TR-ERL-389 ..... N78-21708 #

NOAA-77111506 ..... N78-21731 #
NOAA-77111806 ..... N78-21744 #
NOAA-77112301 ..... N78-22014 #
NOAA-77112302 ..... N78-22015 #
NOAA-77112303 ..... N78-21711 #
NOAA-77120101 ..... N78-21584 #
NOAA-77120103 ..... N78-21733 #
NOAA-77120104 ..... N78-21106 #
NOAA-77120105 ..... N78-21708 #
NOAA-77120106 ..... N78-21730 #
NOAA-77120503 ..... N78-21718*#
NOAA-77120702 ..... N78-21734 #
NOAA-77122003 ..... N78-21312 #
NOAA-78011601 ..... N78-21421 #
NOAA-78011603 ..... N78-21732 #
NOAA-78011611 ..... N78-21506 #
NOAA-78020801 ..... N78-21980 #

NORDA-1 ..... N78-21696 #

NOSC/IR-772 ..... N78-21702 #

NPS-67LI77091 ..... N78-21102 #
NPS-67NT77091 ..... N78-21166 #
NPS-69SL77071-R ..... N78-21416 #

NPS55-77-32 ..... N78-21482 #

NRC-76-20 ..... N78-21662 #

NRL-MR-3551 ..... N78-21923 #
NRL-MR-3553 ..... N78-21375 #
NRL-MR-3572 ..... N78-21924*#
NRL-MR-3591 ..... N78-21451 #
NRL-MR-3611 ..... N78-21452 #
NRL-MR-3620 ..... N78-21382 #
NRL-MR-3639 ..... N78-21698 #
NRL-MR-3646 ..... N78-21983 #
NRL-MR-3657 ..... N78-21500 #
NRL-MR-3661 ..... N78-21738 #
NRL-MR-3664 ..... N78-21748 #
NRL-MR-3669 ..... N78-21446 #
NRL-MR-3681 ..... N78-21380 #

NRL-8156 ..... N78-21298 #
NRL-8161 ..... N78-21237 #
NRL-8167 ..... N78-21433 #
NRL-8185 ..... N78-21497 #

NSF-77-1 ..... N78-22018 #

NSF/IDOE-77-173 ..... N78-21745 #
NSF/IDOE-77-175 ..... N78-21742 #
NSF/IDOE-77-176 ..... N78-21746 #

NSF/RA-770161 ..... N78-21713 #
NSF/RA-770323 ..... N78-21990 #
NSF/RA-770335 ..... N78-21660 #

NSWC/WOL/TR-77-162 ..... N78-21299 #

NTSB-AAR-78-3 ..... N78-21064 #

NTSB-AAS-78-1 ..... N78-21063 #

NYSDOT-ERD-77-RR-53 ..... N78-21300 #

NYSERDA-75/25 ..... N78-21618 #
NYSERDA-75/126 ..... N78-21657 #

N00014-0860/5 ..... N78-21499 #
N00014-0860/6 ..... N78-21502 #

OEO-LN-2137 ..... N78-21654 #
OEO-LN-2138 ..... N78-21656 #

ONR-CR213-155-IF ..... N78-21387 #

ORAU/IEA(M)-77-1 ..... N78-21652 #
ORAU/IEA(M)-77-5 ..... N78-21653 #

ORAU/IEA(M)-77-18 ..... N78-21643 #

ORNL-NUREG-23 ..... N78-21422 #

ORNL-TR-4355 ..... N78-21484 #

ORNL-5340 ..... N78-21283 #

ORNL/CSD/TM-41 ..... N78-21816 #
ORNL/TM-5986 ..... N78-21967 #
ORNL/TM-6065 ..... N78-21929 #
ORNL/TM-6075 ..... N78-21935 #

OR14834 ..... N78-21378 #

OSUNF-784131-2 ..... N78-21273 #

OWRT/S-78/1 ..... N78-21620 #

P-1275-VOL-2 ..... N78-21168 #

PB-275326/7 ..... N78-21672 #
PB-275327/5 ..... N78-21673 #
PB-275391/1 ..... N78-21674 #
PB-275393/7 ..... N78-21675 #
PB-275429/9 ..... N78-21436 #
PB-275576/7 ..... N78-21655 #
PB-275581/7 ..... N78-21713 #
PB-275656/7 ..... N78-21656 #
PB-275658/3 ..... N78-21654 #
PB-275683/1 ..... N78-21676 #
PB-275721/9 ..... N78-21247 #
PB-275756/5 ..... N78-21712 #
PB-275757/3 ..... N78-21300 #
PB-275772/2 ..... N78-21659 #
PB-275786/2 ..... N78-21987 #
PB-275790/4 ..... N78-21583 #
PB-275791/2 ..... N78-21988 #
PB-275827/4 ..... N78-21314 #
PB-275858/9 ..... N78-22014 #
PB-275859/7 ..... N78-22015 #
PB-275876/1 ..... N78-21313 #
PB-275886/0 ..... N78-21581 #
PB-275887/8 ..... N78-21582 #
PB-275895/1 ..... N78-21315 #
PB-275938/9 ..... N78-21990 #
PB-275997/5 ..... N78-21579 #
PB-276006/4 ..... N78-21619 #
PB-276028/8 ..... N78-21978 #
PB-276031/2 ..... N78-21744 #
PB-276040/3 ..... N78-21585 #
PB-276048/6 ..... N78-21977 #
PB-276070/0 ..... N78-21741 #
PB-276082/5 ..... N78-21660 #
PB-276094/0 ..... N78-21976 #
PB-276097/3 ..... N78-21711 #
PB-276108/8 ..... N78-21815 #
PB-276123/7 ..... N78-21103 #
PB-276130/2 ..... N78-21618 #
PB-276131/0 ..... N78-21657 #
PB-276140/1 ..... N78-21731 #
PB-276174/0 ..... N78-21620 #
PB-276180/7 ..... N78-21985 #

PB-276269/8 ..... N78-21621 #
PB-276297/9 ..... N78-21745 #
PB-276350/6 ..... N78-21681 #
PB-276354/8 ..... N78-21586 #
PB-276355/5 ..... N78-21707 #
PB-276375/3 ..... N78-21989 #
PB-276384/5 ..... N78-21979 #
PB-276386/0 ..... N78-21584 #
PB-276388/6 ..... N78-21708 #
PB-276400/9 ..... N78-21819 #
PB-276402/5 ..... N78-21730 #
PB-276410/8 ..... N78-21669 #
PB-276418/1 ..... N78-21658 #
PB-276429/8 ..... N78-21106 #
PB-276430/6 ..... N78-21733 #
PB-276437/1 ..... N78-21287 #
PB-276449/6 ..... N78-21661 #
PB-276467/8 ..... N78-21734 #
PB-276479/3 ..... N78-21718*#
PB-276486/8 ..... N78-21746 #
PB-276489/2 ..... N78-21667 #
PB-276504/8 ..... N78-21327 #
PB-276520/4 ..... N78-21680 #
PB-276532/9 ..... N78-21742 #
PB-276533/7 ..... N78-21743 #
PB-276549/3 ..... N78-21244 #
PB-276580/8 ..... N78-21325 #
PB-276583/2 ..... N78-21668 #
PB-276620/2 ..... N78-21248 #
PB-276637/6 ..... N78-21670 #
PB-276639/2 ..... N78-21992 #
PB-276640 ..... N78-21993 #
PB-276669/9 ..... N78-21328 #
PB-276680/6 ..... N78-21677 #
PB-276681/4 ..... N78-21678 #
PB-276716/8 ..... N78-21682 #
PB-276768/9 ..... N78-21679 #
PB-277095/6 ..... N78-21980 #
PB-277100/4 ..... N78-21312 #
PB-277102/0 ..... N78-21732 #
PB-277103/8 ..... N78-21421 #
PB-277104/6 ..... N78-21506 #

PMSA-2-6 ..... N78-21812 #

POLY-EE/EP-77-207 ..... N78-21925 #

POR-3702 ..... N78-21402 #

PPPL-1382 ..... N78-21930 #

PR-2 ..... N78-21092*#
PR-77-14-36 ..... N78-21195 #
PR-677 ..... N78-21462 #

PSAD-78-12 ..... N78-21979 #
PSAD-78-54 ..... N78-21978 #

PWA-5506 ..... N78-21058*#
PWA-5534 ..... N78-21111*#

P78-10057 ..... N78-21507*

QR-1 ..... N78-21458 #
QR-2 ..... N78-21617 #
QR-3 ..... N78-21965 #
QR-4 ..... N78-21319 #
QR-5 ..... N78-21604*#

QTPR-1 ..... N78-21810 #

R-SAD-1/78-36 ..... N78-21719*#
R-SAD-12/77-34 ..... N78-21692*#

RADC-TR-77-341-VOL-1 ..... N78-21340 #
RADC-TR-77-341-VOL-2 ..... N78-21341 #
RADC-TR-77-365-VOL-1 ..... N78-21793 #
RADC-TR-77-365-VOL-2 ..... N78-21794 #
RADC-TR-77-365-VOL-3 ..... N78-21795 #
RADC-TR-77-365-VOL-4 ..... N78-21796 #
RADC-TR-77-370 ..... N78-21385 #
RADC-TR-77-371 ..... N78-21825 #
RADC-TR-77-374 ..... N78-21345 #
RADC-TR-77-376-VOL-1 ..... N78-21344 #
RADC-TR-77-376-VOL-2 ..... N78-21357 #
RADC-TR-77-380 ..... N78-21356 #
RADC-TR-77-386 ..... N78-21849 #
RADC-TR-77-387 ..... N78-21377 #
RADC-TR-77-401-VOL-1 ..... N78-21346 #
RADC-TR-77-401-VOL-2 ..... N78-21347 #
RADC-TR-77-433 ..... N78-21378 #

RCA-EASD-TP-2146 ..... N78-21068 #

REC-ERC-77-12 ..... N78-21815 #

REF-M77-76 ..... N78-21742 #
REF-M77-92 ..... N78-21743 #

REPT-41 ..... N78-21745 #
REPT-54 ..... N78-21842*#
REPT-68 ..... N78-21841*#
REPT-76-14 ..... N78-21840*#
REPT-77-3 ..... N78-21960 #
REPT-77-9F1-NUSUC-R2 ..... N78-21282 #
REPT-77-13 ..... N78-21731 #
REPT-77-003A-7722 ..... N78-21327 #
REPT-77AEG596 ..... N78-21044*#
REPT-276-72-05/01 ..... N78-21065 #
REPT-1205 ..... N78-21161*#
REPT-1559 ..... N78-21319 #
REPT-1932FR-1 ..... N78-21572*#
REPT-1942-01-1-1676 ..... N78-21056 #

RI/RD78-125 ..... N78-21238 #

RM-024-1 ..... N78-21210*#

RR-20 ..... N78-21609 #
RR-77-1 ..... N78-21873 #
RR-77-14 ..... N78-21971 #
RR-654 ..... N78-21392 #

RRL-PUBL-488 ..... N78-21444*#

RSC-3359-2 ..... N78-21339*#

R77-912184-21 ..... N78-21289*#
R77-912613-5 ..... N78-21268*#

S-476 ..... N78-21562*#
S-477 ..... N78-21568*#
S-2300 ..... N78-21374*#

SABS-044-PT/DEEL-5-1976-REV-1 ..... N78-21467
SABS-044-PT/DEEL-7-1976 ..... N78-21468
SABS-055-1977-REV-1 ..... N78-21264
SABS-055A-1977 ..... N78-21262
SABS-0138-1977 ..... N78-21263

SAMSO-TR-78-5 ..... N78-21811 #
SAMSO-TR-78-7 ..... N78-21242 #

SAN/1178-1 ..... N78-21640 #
SAN/1202-77/2 ..... N78-21965 #

SAND-77-0521 ..... N78-21070 #
SAND-77-0601 ..... N78-21463 #
SAND-77-0726 ..... N78-21069 #
SAND-77-1188C ..... N78-21968 #

SAR-3 ..... N78-21803 #
SAR-5 ..... N78-21450 #

SARRI-EN-TR-78-02 ..... N78-21475 #

SASR-132 ..... N78-21982 #

SCG-60320R ..... N78-21720*#

SGD-398-PT-1 ..... N78-22014 #
SGD-398-PT-2 ..... N78-22015 #

SIS-7709 ..... N78-21865 #

SOL-77-30 ..... N78-21805 #

SR-1 ..... N78-22013 #

SRI-MP-78-12 ..... N78-21449 #
SRI-MP-78-13 ..... N78-21901 #

SRL-6908 ..... N78-21067 #

SRO-893-6 ..... N78-21626 #
SRO-893-8 ..... N78-21627 #
SRO-893-9 ..... N78-21628 #
SRO-893-10 ..... N78-21629 #

SSL-SER-19-ISSUE-17 ..... N78-21520*#

SSS-R-78-3448 ..... N78-21705 #

STAFF-PAPER-77-28 ..... N78-21990 #

STAN-CS-77-630 ..... N78-21814 #

SU-AIM-299 ..... N78-21866 #

SU-CMR-78-2 ..... N78-21450 #

SU-GL-2753 ..... N78-21459 #
SU-GL-2770 ..... N78-21450 #

SU-SEL-77-037 ..... N78-21982 #
SU-SEL-77-041 ..... N78-21354 #

SU-SOL-77-27 ..... N78-21798 #
SU-SOL-77-29 ..... N78-21806 #

SU-TR-5 ..... N78-21855 #
SU-TR-6 ..... N78-21875 #
SU-TR-9 ..... N78-21856 #
SU-TR-13 ..... N78-21804 #
SU-TR-47 ..... N78-21824 #
SU-TR-72 ..... N78-21804 #
SU-TR-77 ..... N78-21824 #
SU-TR-186 ..... N78-21879 #
SU-TR-245 ..... N78-21855 #
SU-TR-246 ..... N78-21875 #
SU-TR-4207-7 ..... N78-21354 #

SUSTAN-CS-77-614 ..... N78-21866 #

SUTR-1 ..... N78-21864 #

T-932-5-2 ..... N78-21767*#

TASC-TR-1007-1-1 ..... N78-21706 #

THEMIS-UGA-33 ..... N78-21874 #

TID-27747 ..... N78-21323 #

TM-76-51 ..... N78-21419 #

TN-1977-6 ..... N78-21362 #
TN-1977-43 ..... N78-21186 #

TR-EE77-38 ..... N78-21784 #

TR-2 ..... N78-21243 #
TR-2 ..... N78-21880 #
TR-3 ..... N78-21850 #
TR-3 ..... N78-21863 #
TR-8 ..... N78-21878 #
TR-9 ..... N78-21194 #
TR-9 ..... N78-21239 #
TR-9 ..... N78-21757 #
TR-12 ..... N78-21759 #
TR-13 ..... N78-21381 #
TR-13 ..... N78-21856 #
TR-31 ..... N78-21504 #
TR-34 ..... N78-21746 #
TR-38 ..... N78-21501 #
TR-44 ..... N78-21964 #
TR-62 ..... N78-21797 #
TR-129-SER-2 ..... N78-21852 #
TR-572 ..... N78-21820 #
TR-590 ..... N78-21802 #
TR-594 ..... N78-21845 #
TR-606 ..... N78-21801 #
TR-607 ..... N78-21826 #
TR-610 ..... N78-21800 #
TR-612 ..... N78-21799 #
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TR-0078(3451-10)-1 ..... N78-21811 #
TR-0078(3940-02)-2 ..... N78-21242 #
TR-1218-A ..... N78-21974 #
TR-1977-2 ..... N78-21962 #

TREE-1174 ..... N78-21642 #

TRRL-SUPPLEMENTARY-261 ..... N78-21658 #
TRRL-SUPPLEMENTARY-279 ..... N78-21328 #

TT-75-58006 ..... N78-21177*#

TT-76-58159 ..... N78-21409*#

TVA-Y-120 ..... N78-21670 #

T169-67 ..... N78-21196*#

UCLA-ENG-7767 ..... N78-21406*#

UCRL-13751 ..... N78-21650 #
UCRL-52313 ..... N78-21322 #
UCRL-52321 ..... N78-21368 #
UCRL-79322-REV-1 ..... N78-21285 #
UCRL-79586 ..... N78-21286 #
UCRL-79600-PT-2 ..... N78-21936 #
UCRL-79880 ..... N78-21928 #
UCRL-80046 ..... N78-21393 #
UCRL-80094 ..... N78-21867 #
UCRL-80353 ..... N78-21986 #

UIEM-77-18 ..... N78-21361 #

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UILU-ENG-77-2270 ..... N78-21905 #
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USGS/WDR/WA-76/2 ..... N78-21582 #
USGS/WRD/HD-77/056 ..... N78-21586 #
USGS/WRD/HD-77/058 ..... N78-21581 #
USGS/WRD/HD-77/059 ..... N78-21582 #
USGS/WRD/WRI-78/006 ..... N78-21583 #

USSARL-78-4 ..... N78-21769 #

UTIAS-TN-212 ..... N78-21405 #

UTPA-7703 ..... N78-21902 #

V-6381 ..... N78-21415 #

VIMS-CONTRIB-823 ..... N78-21560*#

VPI-SU-ENG-77-23-REV ..... N78-21655 #

WARD-HT-3045-26 ..... N78-21284 #

WDL-TR-7529 ..... N78-21606*#

WP-76-3011-3 ..... N78-21809 #
WP-76-3011-4 ..... N78-21808 #

WQEC/C-77-395 ..... N78-21614 #

W78-02701 ..... N78-21620 #

Y/DA-7477 ..... N78-21217 #

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